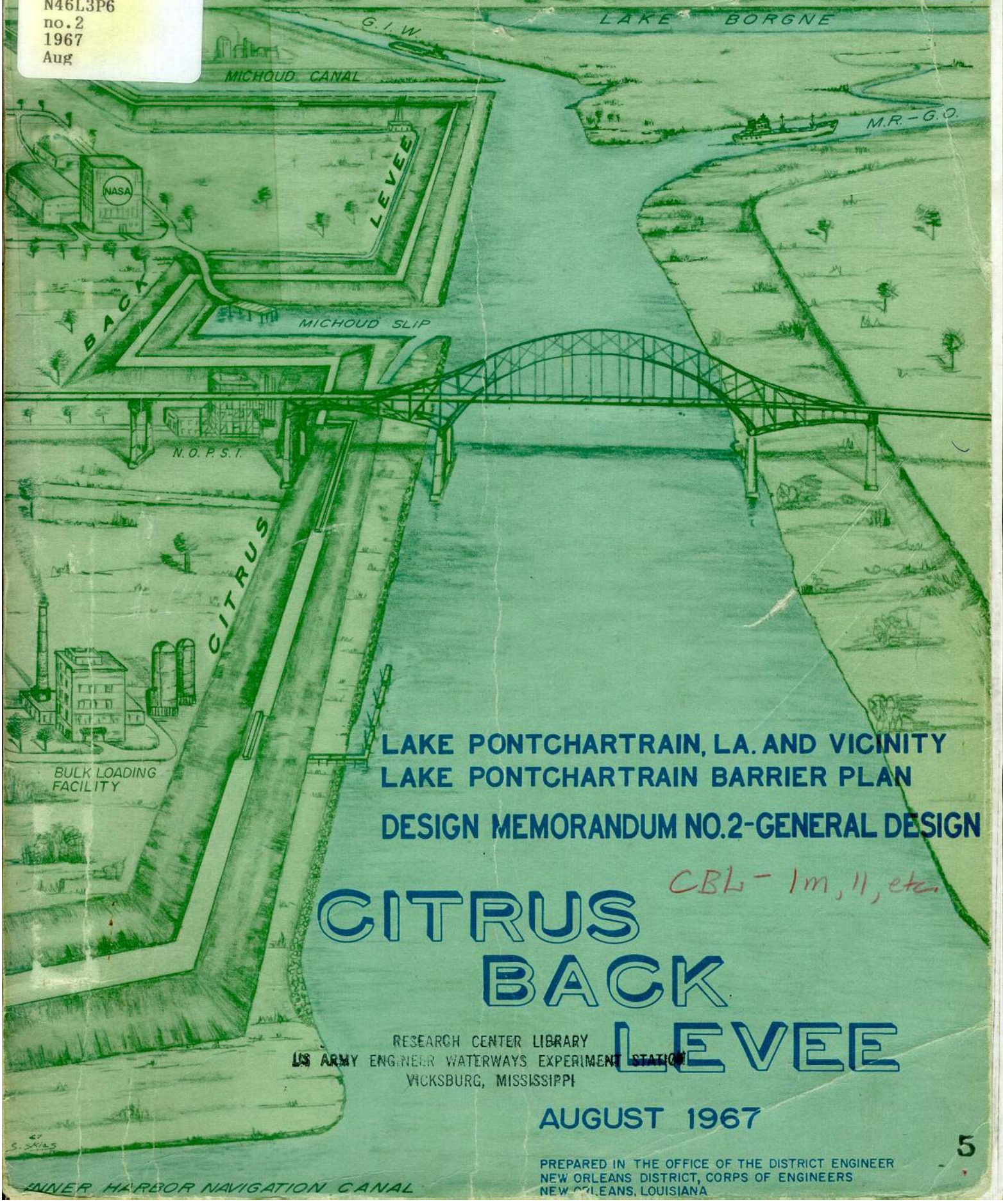

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2-GENERAL DESIGN

CBL - 1m, 11, etc.

CITRUS BACK LEVEE

AUGUST 1967

5

PREPARED IN THE OFFICE OF THE DISTRICT ENGINEER
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

LMVED-TD (NOD 21 Aug 67) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Citrus Back Levee

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 22 Jan 68

TO: District Engineer, New Orleans, ATTN: LMNED-PP

1. Referred to note approval subject to comments contained in previous indorsements.

2. A study should be made of the possible alignment problems mentioned in para 2, 2d Ind, and a discussion thereof included in your 4th Ind to this chain, along with your recommendations.

Consideration should be given as to the requirements for spoil e disposal of dredge spoil from foreseeable construction and ice dredging in the area, if this has not already been done.

FOR THE DIVISION ENGINEER:

George B. Davis

GEORGE B. DAVIS
Acting Chief, Engineering Division

ENGCW-EZ (LMNED-PP, 21 Aug 67) 2nd Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Citrus Back Levee

DA, CofEngrs, Washington, D. C., 20315, 29 December 1967 Ltr LMVD 5 Jan 68

TO: Division Engineer, Lower Mississippi Valley Division

1. Approved, subject to the comments of the Division Engineer and the following comment.

2. The alignment of the proposed levee work at the junction of the Mississippi River-Gulf Outlet Channel and the Inner Harbor Canal is located in fairly close proximity to the existing bank lines. The Division Engineer should satisfy himself that alignment shown has been fully coordinated with plans for future improvements for navigation in this area and that adequate space has been retained for any future enlargement of the junction that may be necessary for navigation.

FOR THE CHIEF OF ENGINEERS:

wd Incls

WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

LMVED-TD (NOD 21 Aug 67) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Citrus Back Levee

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 29 Sep 67

TO: Chief of Engineers, ATTN: ENGCW-V/ENGCW-E

Subject DM is forwarded for review and approval pursuant to para 17, ER 1110-2-1150. Approval is recommended, subject to the attached comments.

FOR THE DIVISION ENGINEER:

A. J. DAVIS
Chief, Engineering Division

2 Incl
wd 2 cy incl 1
Added 1 incl
2. Comments

Copy furnished:
NOD, ATTN: LMNED-PP
w/marked cy incl 1 &
cy incl 2

September 1967

DEPARTMENT OF THE ARMY
LOWER MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
VICKSBURG, MISSISSIPPI 39180

COMMENTS ON DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN, CITRUS BACK LEVEE, LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, INCLOSED WITH LETTER, LMNED-PP, 21 AUGUST 1967, SUBJECT: LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, LAKE PONTCHARTRAIN BARRIER PLAN, DESIGN MEMORANDUM NO. 2 - GENERAL, CITRUS BACK LEVEE

1. Pertinent Data. The tabulation for item "area benefited" does not show acres, but shows monetary benefits. It is suggested that the breakdown here for benefits be deleted and added on the following page under "annual benefits."

2. Paras 46 through 50, pages 19-21. a. From Stations 430+95 to 454+80, it appears that some sheet piling should extend to el -13 and some to el -14 to provide a minimum factor of safety of 1.5 for static water load case, and 1.25 for the dynamic case (see Plates 45, 47, and Figure D-4). Thus, the reason for recommending a pile tip elevation of -10 for the entire reach is not apparent.

b. The analysis of the stability of the I-type wall from Stations 571+55 to 584+23.6 for the dynamic case should be presented. In this reach, the top of the wall is shown at elevation 22.0 or 4 feet above the levee net grade. The reason for this should be explained, as in the remaining reaches, the top of the wall is 2 feet above the adjacent levee net grade.

3. Para 53, page 22. The reference to Plate 47 apparently should be Plate 43.

4. Para 54, Table 3, pages 22 and 23. a. Recheck the settlements for levees west of Paris Road and the ramp. The table shows the base settlements larger than crown settlements. Usually, the crown settles more than the base because of consolidation of the embankment.

b. The assumptions made in the settlement analysis should be given and should indicate whether the settlement values were adjusted for the influence of lateral spreading of the foundation.

5. Para 56, page 24. Clearly indicate that it is planned to construct the first lift to the grades shown for the final levee on Plates 6 through 9.

6. Paras 58 and 59, page 24. In view of the soft foundation soils and probability of large settlements and displacements, we consider that sufficient engineering measurement data should be obtained at two levee sections to permit an evaluation of the design and adequacy of proposed construction sequence. The instruments should be installed prior to placing the first lift and should be observed during and after construction of the first and successive lifts. Devices should include but not necessarily be limited to deep permanent bench marks, piezometers, settlement plates and plugs, slope inclinometers, and surface reference hubs. One installation should be at about Station 235+00 near Borings 2-U and 3-U. The other site should be east of Paris Road. Although two undisturbed borings (4-MU and 4-MUT) were made near Station 573+00, this location may not be a good site for instrumentation because the sand zone encountered from elevation -20 to elevation -35 does not appear to exist from Paris Road to Station 555+ based on Plate 35. The instrument site proposed east of Paris Road should be considered further and resolved with LMVD before construction.

7. Para 69, page 27. The referenced Plate 15 in third line from end of paragraph should be 16.

Cost Estimates

8. Para 89, page 32, Citrus Back Levee. The statement as to the construction cost of the Citrus Back Levee does not agree with the detailed estimate in Table 4 (pages 34 and 35). Paragraph 89 shows the total first cost of construction to be $8,389,000. Table 4 indicates that this estimated cost includes the Engineering and Design and Supervision and Administration less the feature amounts chargeable to the Mississippi River-Gulf Outlet project, for foreshore protection. The statement in para 89 should be reconciled with the detailed estimate in Table 4. The statement should be revised as follows:

"Based on July 1967 price levels the estimated first cost for the Citrus Back Levee excluding that portion of the foreshore protection chargeable to the Mississippi River-Gulf Outlet project is $11,900,000. This estimate consists of $3,215,000 for Lands and Damages, $296,000 for Relocations, $7,269,000 for Levees and Floodwalls, $618,000 for Engineering and Design and $502,000 for Supervision and Administration. Detailed estimates of first cost are shown in Table 4."

9. Table 4, pages 34 - 37. A recapitulation of the detailed estimate should be included at the end of the detailed estimate as follows:

September 1967

		Total Est. Cost Citrus Back Levee	Estimate of Foreshore Protection Chargeable to MR-GO	Net Est. Cost for Citrus Back Levee
01.	Lands & Damages	$ 3,215,000	$ 0	$ 3,215,000
02.	Relocations	296,000	0	296,000
11.	Levees & Floodwalls	7,835,000	566,000	7,269,000
30.	E&D	666,000	48,000	618,000
31.	S&A	541,000	39,000	502,000
	TOTAL	$12,553,000	$653,000	$11,900,000

10. Para 90, page 32. The same comments relative to the Citrus Back Levee, para 89, applies to the total construction cost of the Barrier Plan. It is recommended that this paragraph be revised as follows:

"Lake Pontchartrain Barrier Plan. Cost estimates to full design memorandum scope are available only for the Citrus Back Levee and the protective works on the west bank of the IHNC between Florida Avenue and the IHNC Lock. The cost estimates for the remainder of the Barrier Plan are, in general, survey report costs updated to reflect July 1967 price levels. The total estimated first cost for the Lake Pontchartrain Barrier Plan is $121,000,000. This estimate consists of $14,461,400 for Lands and Damages, $1,837,800 for Relocations, $11,689,000 for Locks, $399,000 for Roads, $7,927,400 for Channels and Canals, $60,471,200 for Levees and Floodwalls, $10,473,000 for Control Structures, $7,439,100 for Engineering and Design and $6,302,100 for Supervision and Administration. The total Federal first cost is estimated to be $81,983,500. The total non-Federal first cost including $16,299,200 for Lands and Damages, and Relocations, and a contribution of $22,717,300 in cash or equivalent work is estimated to be $39,016,500. An estimate of the apportionment of cost between Federal and non-Federal interests is shown in Table 5. Survey scope estimates of first cost are shown in Table 6."

11. Table (page 38). Revise as follows:

Table 5

Project first cost:

Construction, E&D, and S&A	$ 104,700,800
Lands, Damages, & Relocations	16,299,200
Total first cost	$ 121,000,000
Less one-half cost of Seabrook Lock 1/	-3,665,000
Cost to be apportioned	$ 117,335,000

September 1967

Apportionment of Costs:	Federal	Non-Federal
Apportionment	82,134,500	35,200,500
One-half cost of Seabrook Lock 1/	+3,665,000	-
OM&R Rigolets Lock 2/	-3,816,000	+3,816,000
Total Costs	81,983,500	39,016,500
Lands, Damages & Relocations	-	-16,299,200
Cash Contribution	-	22,717,300

1/ One-half the cost of Seabrook Lock is allocated to the navigation purpose and is all Federal cost. The other half of the cost is apportioned to Federal and non-Federal interests on a 70/30 basis.

2/ Local interest contribution for the capitalized cost of OM&R of the Rigolets Lock.

12. Table 6, page 39. a. The note at the top of the Table reads as follows: "Project document cost escalated to July 1967 price levels (except as noted)." Items on pages 39, 41, 44, and 59 are noted by asterisks as follows: "1 July 1967 price levels." A distinction should be made. ~~Probably~~ If the asterisk intends to convey the idea that the items so marked have been reanalyzed and the costs shown reflect the reanalysis based on 1 July 1967 price level, ~~Probably,~~ the asterisk note should read as follows: "Estimate for these items reanalyzed to reflect current requirements at July 1967 price levels."

b. It is noted that the estimate for 09., Channels and Canals, on page 40, is not the project document estimate because the estimated quantity is different from that shown in Table D-3 of the project document, and the unit price is not consistent. Furthermore, throughout the estimate, the amounts for E&D and S&A cannot be reconciled with the amounts in the project document.

c. Any deviation from the project document should be noted as stated at the head of the tables and changes from the project document should be explained.

d. It is noted throughout Table 6 that no price level increase has been taken for Lands and Relocations. Therefore, this is another example where the estimates do not agree with the note at the head of the table.

e. On page 50, no price level increase has been taken for Citrus Levee and this feature should be footnoted on page 50 to show exactly the basis for the estimates shown by making reference to the GDM and the date of the price level. The detailed estimate on Table 3 pertains to settlement during construction and is not a detailed cost estimate. This discrepancy should be corrected.

f. No price level change from project document is reflected in the estimates on pages 51, 52, 53, 54, and 55.

g. Price level increase is taken for the drainage structure on page 56, although it is footnoted to represent December 1961 price level. This inconsistency should be eliminated. However, for the Lake Front Levee, no price level increase is taken at all and this applies also to the items on pages 57 and 58.

h. A price level increase is taken for Seabrook Lock structure on page 59 and for the two units on page 60, although the latter two units indicate December 1961 price level. This inconsistency should be eliminated.

i. Table 6 should be reviewed carefully by the district to indicate exactly the status of the estimates and remove the confusion that now exists.

13. Table 6, pages 39 to 60. A variation in unit prices used for the following items should be explained:

a. Riprap prices vary from $6.50 to $13.00 per ton.

b. Reinforcing steel prices vary from $0.15 to $0.175 per pound.

c. Sheet pile MA-22 prices vary from $3.00 to $4.00 per sq. foot.

d. Sheet pile Z-27 prices vary from $3.25 to $4.50 per sq. foot.

e. Sheet pile Z-32 prices vary from $4.50 to $5.25 per sq. foot.

14. Paras 91 and 92, page 61, Comparison of Costs. Although the differences between the project document and the PB-3, effective 1 Jul 67, and between the project document and the current estimate in this GDM are shown in Tables 7 and 8; these differences are not explained in the Comparisons of Cost statements. An explanation of each difference should be given in accordance with para 7t, ER 1110-2-1150. This explanation should be shown for both the Citrus Back Levee, paragraph 91, and the entire Barrier Plan presented in paragraph 92. In each of these paragraphs, the explanation for increase in Engineering and Design is unsatisfactory. E&D does not necessarily increase along with the increase in price level. A more specific explanation should be furnished for this feature in each paragraph.

The increase in cost set forth in Design Memorandum No. 2 over the estimate in the PB-3 having an effective date of 1 July 1967, will not be included in future PB-3's pending receipt of approval of GDM No. 2 and instructions from LMVD.

15. Plate 2. A curved alignment would appear desirable at Station 176+75.9, especially if the crown is ever to be used for movement of vehicles or equipment.

16. Plate 4. A curved levee alignment at angle points would be desirable, especially if the crown is to be used forthe movement of vehicles or equipment, and should be considered.

17. Plate 18. Orienting gate No. 3 as shown in red is suggested.

18. Plate 25. Suggest a steel bearing plate be provided at the top and bottom beams, and the 1-3/4 in. x 1-3/4 in. steel bar be omitted.

19. Plate 26. a. Typical I-wall section. (1) Rebars passing through the steel sheet piling should be spaced with the piling sections. For example, two bars through each pile section will require one hole in each flange. This will eliminate the need to shift bars in the field to avoid pile webs, or interlocks, and will permit burning, or punching, the holes in the shop. The maximum size hole should be specified to prevent oversize holes.

(2) Except for very low walls, transverse reinforcement (stirrups) should be placed across the wall at the top of the sheet piling. Since tension cracks will, or may, develop at this point, the stirrups should be designed to take the total shear. This is based on the assumption that the crack transmits no shear, thus concentrating the total shear in the compression zone which is outside the piling, and in the absence of transverse reinforcement, will tend to split the concrete.

b. Typical Joint Between I-Wall and T-Wall or Gate. (1) The fact that the Z-27 sheet piling under the I-wall extends across the joint and is embedded in the T-wall will cause a transfer of load to the T-wall, and may cause splitting of the concrete. The details of this joint should be studied further.

(2) The rubber seal should be installed under enough initial deflection so that opening of the expansion joint will not break the seal contact.

c. Typical I-Wall Monolith Joint. The rubber water stop located as shown will weaken the corner and may cause spalling. Suggest the distance from the wall face be not less than about 6 inches. This will require a change in the typical I-wall section. Suggest the section be modified as indicated in red. The water stop can be ended 6 inches below the top.

d. Typical T-Wall Section. Rebars passing through the piling should be spaced with the piling sections; for example, two bars through each section. In this case, using one bar through each section would permit using the handling hole. Where the handling hole is to be used, the location should be dimensioned to insure proper location.

20. Plate 27. The Federal Specification SS-S-00210 is not listed in the current index of Federal Specifications, and apparently is obsolete.

21. Plate 37. a. The analysis shown at the top of the plate entitled "No Canal Side Pit" is not typical for the entire reach from Station 176+75.9 to Station 253+40 as noted. Based on a study of Plates 2 and 6, it appears that this reach can better be represented and analyzed as follows:

(1) Station 176+75.9 to Station 195+00 (approximate). Existing levee with spoil on protected side, no foreshore protection, and available borrow commencing 140 feet from the levee enlargement centerline.

(2) Station 195+00 (approximate) to Station 204+00 (approximate). The analysis entitled "No Canal Side Pit" on Plate 37 is considered representative of the reach from Station 195+00 to Station 204+00, and is considered satisfactory except as noted in subparagraph c below.

(3) Station 204+00 (approximate) to Station 222+00 (approximate). Existing levee section with protected side groundline at approximate el 0.0, existing borrow pit on flood side, foreshore protection, and available borrow commencing at a distance from the levee enlargement centerline to provide adequate stability. The levee enlargement section and available borrow location will probably be similar to either levee design sections 2 (Plate 6) or 5 (Plate 7).

(4) Station 223+00 (approximate) to Station 253+40 (approximate). Same conditions cited for subparagraph a(3) above. The levee enlargement section and available borrow location will probably be similar to either levee design sections 3 (Plate 6) or 5 (Plate 7).

b. If the reaches discussed in subparagraphs a(3) and (4) above are both similar to levee design section 5 (Plate 7), no additional floodside analyses are required for these reaches as levee design section 5 is satisfactorily analyzed on Plate 37 (with Canal Side Pit, Station 279+00 to Station 409+00).

c. The reaches discussed above should be analyzed for the criteria and conditions set forth in paragraph 51, page 21, of this design memorandum. It is not apparent if the stability of sections presented on Plate 37 were analyzed for sliding toward the landside as described in paragraph 51. The results of the landside analyses should be presented.

d. Consideration should be given to backfilling the existing floodside borrow pits and thickening the floodside berm several feet so as to provide a continuous dressed floodside slope. This will prevent floodside borrow pit ponding and provide additional stability for these sections. This comment also applies to the section for Station 508+00 to Station 540+45 on Plate 40.

e. Each stratum should be noted to indicate the type of material.

22. Plates 40 through 42. a. The factor of safety with respect to uplift for the new drainage ditch between Station 495+19 and Station 625+77 should be checked.

b. The analyses on Plate 42 show a shear strength of c = 300 psf from elevation 0 to elevation -10 and elevation -3 to elevation -10. The basis for using this strength instead of c = 250 psf as shown on Boring 4-MUT is not apparent. The analyses should be checked using c = 250 psf.

23. Stability Analyses. Although the stratification and Q design shear strengths shown on the stability analysis plates generally appear to be satisfactory, the basis for their selection should be presented.

24. Field Explorations. The number of undisturbed borings and tests is not adequate to reliably indicate foundation conditions for this reach of protection. As comparisons must later be made between available data and the borings and test data to be obtained as per paragraph 59, additional borings and basic soil test data should be obtained on undisturbed samples of foundation before constructing the first lift. This should be done for representative reaches along the proposed protection.

25. Appendixes. The pages and plates should be numbered with a prefix.

26. Appendix D. a. Figures D-7 and D-8. The crown of the levee should be shown on Figure D-7. It is noted that the calculations on Figure D-8 are based on the crown at elevation 11, whereas the Plan-Profile indicates elevation 9.

b. Figure D-9. The effect of the steel sheet piling in its capacity to support both vertical and horizontal loads has been neglected. By inspection, it appears that this is on the side of safety.

c. Figure D-16. Variations in K will also cause variations in the axial pile loads. From the description of the design procedure, it is not clear whether or not this is taken into account.

d. Figures D-18 and D-19. The transverse pile load should be included in the moment analysis. Cognizance should be taken of the fact that moment in the sheet piling will produce a resisting couple in

the base which will add to the stress in the reinforcement.

e. Figure D-20. The assumption that one pile fails is unnecessarily conservative. The factor of safety in working stresses should be ample to take care of variation in pile loads.

f. Figure D-30. Metal in the proposed ST3B4.25 is thin. A thicker section would be desirable.

g. Figure D-31. Suggest that the gusset plates be located to coincide with a vertical rib.

27. Refer to other comments marked in red on pages 18, 20, 21, 22, 40, 47, 60; Plates 2, 3, 5, 8, 9, 18, 22, 24, 25, 26, 37, 39, 40, 41, 42; Figures D-1, -7, -8, -9, -11, -12, -14, -20, -21, -42, and D-43.

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-PP

21 August 1967

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 2 - General, Citrus Back Levee

TO: Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

1. The subject design memorandum is submitted herewith for review and approval in accordance with the provisions of ER 1110-2-1150 dated 1 July 1966.

2. Approval of the memorandum is recommended.

Thomas J Bowen

1 Incl (16 cys)
GDM No. 2

THOMAS J. BOWEN
Colonel, CE
District Engineer

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
DESIGN MEMORANDUM NO. 2 - GENERAL
CITRUS BACK LEVEE

STATUS OF DESIGN MEMORANDA

Design memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Submitted Aug 67
	Part III - Lakeshore	Scheduled Jul 68
	Part IV - Chalmette Extension	Scheduled Sep 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Submitted Aug 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Scheduled Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Scheduled Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Complex	Scheduled Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Scheduled Jul 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees	Scheduled Apr 70

STATUS OF DESIGN MEMORANDA (cont'd)

Design memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Scheduled Dec 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Scheduled Feb 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees	Scheduled Nov 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee From South Point to GIW	Scheduled Mar 69
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan GDM, Supplement No. 1, Chalmette Extension	Scheduled Feb 68
4	Lake Pontchartrain Barrier Plan & Chalmette Area Plan, GDM Florida Avenue Complex, IHNC	Not scheduled
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre	Scheduled Sep 67
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Scheduled Feb 69
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Feb 69
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Scheduled Feb 69
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled Jan 69

STATUS OF DESIGN MEMORANDA (cont'd)

Design memo No.	Title	Status
10	Lake Pontchartrain Barrier Plan, DDM, Gantry Crane - Chef Menteur Control Structure	Scheduled Jan 70
11	Lake Pontchartrain Barrier Plan, DDM, St. Charles Parish Drainage Structure	Scheduled Jan 70
12	Source of Construction Materials	Approved 30 Aug 66
13	Lake Pontchartrain Barrier Plan, DDM, Gantry Crane - Rigolets Control Structure	Scheduled Jul 70
14	Beautification	Not scheduled
1	Lake Pontchartrain, La. and Vicinity,and Mississippi River-Gulf Outlet, La., GDM, Seabrook Lock	Scheduled Feb 68
2	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., DDM, Seabrook Lock	Scheduled Oct 68

LEGEND

EXISTING IMPROVEMENTS

- Levee
- Seawall
- Location of work covered in this document.

AUTHORIZED IMPROVEMENTS

- New Levee
- Levee Enlargement
- Control Structure
- Drainage Structure
- Lock
- Floodgate
- Navigation Channel
- Floodwall
- Seawall Strengthening
- Rock Fill

LAKE PONTCHARTRAIN

LAKE MAUREPAS

PASS MANCHAC

Mandeville

Seawall

190

LAKE PONTCHARTRAIN CAUSEWAY

ST. JOHN THE BAPTIST PARISH / ST. CHARLES PARISH

ST. CHARLES PARISH / JEFFERSON PARISH

JEFFERSON PARISH / ORLEANS PARISH

BONNET CARRÉ SPILLWAY

ST CHARLES PARISH

JEFFERSON PARISH

NEW ORLEANS

MISSISSIPPI RIVER

New Orleans Lakefront Airport

Seabrook Lock

Seawall

FLORIDA AVE. BRIDGE

INNER HARBOR NAVIGATION CANAL

EXISTING LOCK

CITRUS

NEW ORLEANS EAST

ST. TAMMANY PARISH / ORLEANS PARISH

Apple Pie Ridge

THE RIGOLETS

South Point

CHALMETTE

Chalmette

Violet

Bayou Dupre

Verret

WATERWAY

ORLEANS PARISH / ST. BERNARD PARISH

CHEF MENTEUR PASS

GULF INTRACOASTAL

MISSISSIPPI RIVER - GULF OUTLET

LAKE BORGNE

10 · 90 · 11 · 47 · 61 · 46

N

SCALE OF MILES

1 0 1 2 3 4 5

LAKE PONTCHARTRAIN AND VICINITY, LA. (HURRICANE PROTECTION)

AUTHORIZED PLAN OF PROTECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

NOVEMBER 1965 FILE NO. H-2-23693

REV. MAY 1967

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL

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PLATES

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PLATES (cont'd)

PERTINENT DATA

Location of project		Southeastern Louisiana in Orleans, Jefferson, St. Charles, and St. Tammany Parishes
Hydrologic data		
Temperature	Maximum monthly	87.1 degrees Fahrenheit
	Minimum monthly	43.0 degrees "
	Average annual	69.7 degrees "
Net grade of protection works		
Inner Harbor Navigation Canal to Paris Road		El. 14.0*
Paris Road through NASA		El. 18.0
Rights-of-way		340 acres
Estimated first cost		
Lake Pontchartrain Barrier Plan		
Federal		$ 81,983,500
Non-Federal		39,016,500
Total		$121,000,000
Area benefited - Lake Pontchartrain Barrier Plan		
Flood damage prevented		$ 65,951,400
Increased land utilization		358,600

* Unless otherwise specified all elevations herein are in feet and refer to mean sea level datum.

PERTINENT DATA (cont'd)

Annual precipitation	Maximum	85.73 inches
	Minimum	31.07 inches
	Average	60.58 inches

Hydraulic design criteria - Tidal

Design hurricane - Standard Project Hurricane (SPH)	
Frequency	1 in 200 years
Central Pressure Index (CPI)	27.6 inches of mercury
Maximum 5-minute average wind	100 m.p.h.

Floodwall - Citrus Back Levee

Station 253+35 to 271+55

430+95 to 454+80

541+55 to 584+23.6

Levee - Citrus Back Levee

Station 176+75.9 to 253+40

271+50 to 431+00

454+75 to 571+60

584+75 to 664+73.3

Economic justification - Lake Pontchartrain Barrier Plan

Annual charges	
Federal	$ 3,085,000
Non-Federal	1,837,800
Total	4,922,800
Annual benefits	66,310,000
Benefit - cost ratio	13.5 to 1

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL

PROJECT AUTHORIZATION

1. Authority. Public Law 298-89th Congress, 1st Session, approved 27 October 1965, authorized the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 231, Eighty-Ninth Congress, except that the recommendations of the Secretary of the Army in that document shall apply with respect to the Seabrook Lock feature of the project.

2. The report of the Chief of Engineers, dated 4 March 1964, and printed in House Document No. 231, 89th Congress, 1st Session, submitted, for transmission to Congress, the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers and the concurring report of the Mississippi River Commission for those areas under its jurisdiction. The report of the Board of Engineers for Rivers and Harbors stated "...For protection from hurricane flood levels, the reporting officers find that the most suitable plan would consist of a barrier extending generally along United States Highway 90 from the easternmost levee to high ground east of the Rigolets, together with floodgates and a navigation lock in the Rigolets, and flood and navigation gates in Chef Menteur Pass; construction of a new lakeside levee in St. Charles Parish extending from the Bonnet Carre Spillway guide levee in and along the Jefferson Parish line; extension upward of the existing riprap slope protection along the Jefferson Parish levee; enlargement of the levee landward of the seawall along the 4.1-mile lakefront, and construction of a concrete-capped sheet-pile wall along the levee west of the Inner Harbor Canal in New Orleans; raising the rock dikes and landward gate bay of the planned Seabrook Lock; construction of a new levee landward of the Southern Railway extending from the floodwall at the New Orleans Airport to South Point; enlargement of the existing levee extending from United States Highway 90 to the Gulf Intracoastal Waterway, thence westward along the waterway to the Inner Harbor Canal, together with riprap slopes along the canal, construction of a concrete-capped sheet-pile wall along the east levee of the Inner Harbor Canal between the Gulf Intracoastal Waterway and the New Orleans Airport..."

3. Purpose and scope. The purpose of this document is twofold: it will serve to present, in summary form and based generally on refinement and updating of the information contained in the authorizing document, the features, layout, costs and economics of the Lake Pontchartrain Barrier Plan; and, in addition, will contain the

essential data, assumptions, criteria, computations, design and costs for the Citrus Back Levee in sufficient detail to provide an adequate basis for preparing plans and specifications for the levee without additional design analyses.

4. Ordinarily, the general design memorandum for a project is not submitted until preliminary design studies for all project features have been completed (Ref. ER 1110-2-1150, Par. 5.d.). In the instant case, however, the overall complexity of the project, the number of project features involved, and the need to concentrate available design capability on the detailed design of features for which there is an urgent need for early construction precluded this procedure since it would have inordinately delayed submission of the general design memorandum. A decision was accordingly taken to present the general design memorandum in the form of a skeletonized initial document which will be expanded in scope and form by the addition of supplementary documents as design studies progress. This concept was further expanded to provide for preparation and submission of a supplement covering the protective works on the Inner Harbor Navigation Canal (IHNC) in advance of submission of the general design memorandum, as a means of providing for the earliest practicable construction on the Lake Pontchartrain Barrier Plan, and this recommendation was approved on 18 November 1966. The basic procedure was described and recommended in LMNED-PP letters dated 7 October 1965 and 5 November 1965, entitled "Outline of Proposed Planning Procedure for Proposed 'Lake Pontchartrain, La. & Vicinity' project" and "Revised Outline of Planning Procedures 'Lake Pontchartrain, La. & Vicinity,' project," respectively, and approved in 1st Indorsement to the latter, which indorsement also suggested limiting the detailed coverage in the general design memorandum to the Citrus Back Levee. This suggestion has been adopted. By LMNED-PP letter dated 8 November 1966, it was recommended that the coverage in the advance supplement for the IHNC be limited to the critical area on the west bank of the IHNC between the IHNC Lock and Florida Avenue and this recommendation was approved on 18 November 1966. The advance supplement was submitted on 13 March 1967 and approved on 31 May 1967. Copies of the above correspondence are included in appendix A. A list of remaining supplements to the general design memorandum and the scheduled submission dates therefor is contained herein under "Status of Design Memorandums."

5. Local cooperation. The conditions of local cooperation pertinent to the Lake Pontchartrain Barrier Plan, as specified in the report of the Board of Engineers for Rivers and Harbors and concurred in by the Chief of Engineers, are as follows:

> "...That the barrier plan for protection from hurricane floods of the shores of Lake Pontchartrain...be authorized for construction,...Provided that prior to construction of each separable independent feature local interests furnish assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:

"(1) Provide all lands, easements, and rights-of-way, including borrow and spoil-disposal areas, necessary for construction of the project;

"(2) Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction work;

"(3) Hold and save the United States free from damages due to the construction works;

"(4) Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (1) and (2) above and a cash contribution presently estimated at $14,384,000 for the barrier plan and $3,644,000 for the Chalmette plan, to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;

"(5) For the barrier plan, provide an additional cash contribution equivalent to the estimated capitalized value of operation and maintenance of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $4,092,000, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier;

"(6) Provide all interior drainage and pumping plants required for reclamation and development of the protected areas;

"(7) Maintain and operate all features of the works in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates and approach channels, drainage structures, drainage ditches or canals, floodwalls, seawalls, and stoplog structures, but excluding the Rigolets navigation lock and channel and the modified dual-purpose Seabrook Lock; and

"(8) Acquire adequate easements or other interest in land to prevent encroachment on existing ponding areas unless substitute storage capacity or equivalent pumping capacity is provided promptly;

"Provided that construction of any of the separable independent features of the plan may be undertaken independently of the others, whenever funds for that purpose are available and the prescribed local cooperation has been provided..."

6. The Secretary of the Army, in his letter dated 28 June 1965, noted that the "...Bureau [of the Budget] also discusses cost sharing for the Seabrook facility, and expresses the opinion that under existing circumstances standard methods of cost sharing are inapplicable; consequently, the viewpoint of the Bureau of the Budget is to allocate the cost of the Seabrook feature equally between navigation and hurricane protection. This allocation of costs would result in the additional cost of $687,000 to the local interests and a corresponding reduction in the cost to the United States for the Seabrook Lock. With the understanding that this apportionment of costs would not unduly delay construction, I concur in the views of the Bureau of the Budget..." As previously pointed out, the project was authorized with the proviso that "...the recommendation of the Secretary of the Army in [House Document Numbered 231, Eighty-ninth Congress] shall apply with respect to the Seabrook Lock feature of the project..."

7. Investigations. a. Studies and investigations made in connection with the report on which authorization is based (H.D. No. 231, 89th Congress, 1st Session) include: research of information available from previous reports and existing projects in the area; extensive research into the history and records of hurricanes and hurricane damages; extensive tidal hydraulics investigations involving both office and model studies relating to the ecological impact of the project on Lakes Pontchartrain and Borgne; an economic survey; and preliminary design and cost studies. A public hearing was held in New Orleans on 13 March 1956 to determine the views of local interests.

b. Subsequent to project authorization, detailed investigations were undertaken as follows:

(1) Aerial and topographic surveys of the Citrus Back Levee;

(2) Soils investigations of the Citrus Back Levee, including general and undisturbed type borings and associated laboratory tests and evaluations;

(3) Detailed design studies for levees, I-type and inverted T-type floodwalls, and gap closures including levee section stability determinations;

(4) Tidal hydraulics studies required for establishing design grades for protective works based on revised hurricane parameters furnished by the U. S. Weather Bureau subsequent to project authorization;

(5) Real estate requirements and appraisals;

(6) Cost estimates for levees, floodwalls, gap closures, and relocations;

(7) Office studies evaluating alternate alignments for the Lake Pontchartrain Barrier;

(8) Office studies for determining the optimum controlling elevation of the Seabrook Lock.

LOCAL COOPERATION

8. Local cooperation requirements. The conditions of local cooperation as specified by the authorizing law are quoted in paragraph 5.

9. The authorizing law provides for initiation of construction of each separable unit (Lake Pontchartrain Barrier Plan and Chalmette Area Plan) contingent upon local interests furnishing assurances for the unit. Because of the substantial cash contribution involved, the Division Engineer recommended in LMVPD letter dated 9 December 1965, subject "Lake Pontchartrain and Vicinity, Louisiana," that the project be subdivided into five separable units so that any funds appropriated by the Congress for construction of the project could be used on any separable unit for which the necessary local cooperation is available. The division of the "Lake Pontchartrain, La. and Vicinity," project into five separable units was approved by ENGCW-OC 1st Indorsement dated 4 January 1966 to LMVPD letter dated 9 December 1965. By LMNED-DD letter dated 3 March 1966, subject "Lake Pontchartrain and Vicinity, Louisiana," it was recommended that the project be subdivided into two units as described in the House Document No. 231, inasmuch as assurances for the entire project would soon be accepted. By 1st Indorsement LMVPD dated 14 April 1966 to LMNED-DD letter dated 3 March 1966, the District Engineer was directed to retain a five-unit division, inasmuch as local interests reaffirmed the desire for a five-unit breakdown. Copies of the aforementioned letters dated 9 December 1965 and 3 March 1966 and 1st Indorsements thereto are included in appendix A. The five separable units, as finally defined, are as follows:

Par 9.

Separable unit	Description
New Orleans East	Protective works for the New Orleans, Citrus, and New Orleans East areas; and for the barrier extending from New Orleans East to Apple Pie Ridge.
Chalmette	All protective works in the Chalmette Area Plan.
New Orleans West	Protective works for the St. Charles Parish and Jefferson Parish areas.
Mandeville	Seawall strengthening in the town of Mandeville.
Seabrook Lock	The Seabrook Lock feature which is located at the Lake Pontchartrain end of the Inner Harbor Navigation Canal.

10. Status of local cooperation. On 2 November 1965, the Governor of the State of Louisiana designated the State of Louisiana, Department of Public Works, as "...the agency to coordinate the efforts of local interests and to see that the local commitments are carried out promptly..." By State of Louisiana Executive Order dated 17 January 1966, the Board of Levee Commissioners of the Orleans Levee District was designated as the local agency to provide the required local cooperation for all portions of the "Lake Pontchartrain, La. and Vicinity," project in Orleans, Jefferson, St. Charles, and St. Tammany Parishes. Assurances covering all of the local cooperation required for the Lake Pontchartrain Barrier Plan were requested through the Department of Public Works from the Board of Levee Commissioners of the Orleans Levee District on 21 January 1966, and a satisfactory act of assurances, supported by a resolution of the Board of Levee Commissioners of the Orleans Levee District dated 28 July 1966, was approved and accepted on behalf of the United States on 10 October 1966. The principal officers currently responsible for the fulfillment of the conditions of local cooperation are as follows:

Mr. Leon Gary, Director
State of Louisiana
Department of Public Works
Baton Rouge, Louisiana 70804

Mr. Milton E. Dupuy, President
Board of Levee Commissioners
Orleans Levee District
Room 200, Wild Life and Fisheries Building
418 Royal Street
New Orleans, Louisiana 70130

11. Views of local interests. The Board of Levee Commissioners of the Orleans Levee District represents local interests and is in agreement with the general plan. The estimated non-Federal contribution for the entire Lake Pontchartrain Barrier Plan, including the additional contribution for operation and maintenance of the Rigolets Lock is $39,016,500. The intention and capability of the local sponsor to provide the required non-Federal contribution have been amply demonstrated; in fact, considerable work on the Citrus Back Levee and on a number of the other project features, which will ultimately be incorporated into the overall project, has already been accomplished by the sponsor.

LOCATION OF PROJECT AND TRIBUTARY AREA

12. Project location. The "Lake Pontchartrain, La. and Vicinity" hurricane protection project, as shown on plate 1, is located in southeastern Louisiana in the general vicinity of New Orleans. The project area comprises the lowland and water areas from the Mississippi River alluvial ridge and the west and north shores of Lake Borgne to the Pleistocene escarpment to the north and west. Lake Pontchartrain, a shallow land-locked tidal basin approximately 640 square miles in area and averaging 12 feet in depth, dominates the topography of the area. It connects with lesser Lake Maurepas to the west and through Lake Borgne and Mississippi Sound to the Gulf of Mexico on the east. Project works will be located in the Parishes of Orleans, Jefferson, St. Bernard, St. Charles, and St. Tammany. The project area includes all of the metropolitan area of New Orleans east of the Mississippi River.

13. Tributary area. The tributary area varies in character from flat tidal marsh at or near sea level to upland areas of significant relief with natural ground elevations as high as 250 feet above mean sea level. Runoff from within the project area is disposed of into either Lake Borgne or Lake Pontchartrain, generally by pumping, although some developed areas located on alluvial ridges in St. Charles, St. Bernard, and St. Tammany Parishes are drained by gravity. In addition to runoff from the project area, Lake Pontchartrain receives the runoff of 4,700 square miles located to the north and west of the lake. During major floods on the Mississippi River and its tributaries, floodflows may be diverted from the Mississisppi River to Lake Pontchartrain through the Bonnet Carre' Spillway, a controlled overbank floodway constructed under the Mississippi River and Tributaries project.

14. The total area covered by the Lake Pontchartrain Barrier Plan which is subject to inundation is 451,900 acres comprised of 22,500 acres of residential development; 5,000 acres of commercial and industrial improvements; 37,800 acres of open land; 380,400 acres of swamp, woodland, and marsh; and 6,200 acres of other developed areas. Lack of hurricane flood protection and inadequate interior drainage have retarded the development of the swamp, woodland and marsh areas.

PROJECT PLAN

15. General. The project, as shown on the flyleaf map, consists of two separate and distinct major features - the Chalmette Area Plan, and the Lake Pontchartrain Barrier Plan. This memorandum is concerned only with the latter. The Chalmette Area Plan is described in Design Memorandum No. 3, General Design, dated 1 November 1966, approved 31 January 1967 and LMNED-PR letter dated 29 November 1966, subject "Lake Pontchartrain, La. & Vicinity - Modification of the Chalmette Area Plan to Include Larger Area." The Lake Pontchartrain Barrier Plan provides for construction of a hurricane barrier along the east side of Lake Pontchartrain to limit uncontrolled ingress of hurricane tides into the Lake; a new levee along the St. Charles Parish Lakeshore; a new levee along Citrus and New Orleans East lakeshores; the improvement or enlargement of existing protective works on the south shore of the lake, along the Gulf Intracoastal Waterway (GIW) and the IHNC; strengthening Mandeville seawall; construction of a multipurpose lock in the IHNC at Seabrook for control of salinities in Lake Pontchartrain, currents in the IHNC and hurricane inflow; and necessary modifications to roads, pipelines, pumping stations, and drainage facilities.

16. Citrus Back Levee. The Citrus Back Levee is located on the north bank of the Mississippi River-Gulf Outlet (MR-GO) and the GIW, and extends from a junction with protective works on the east bank of the IHNC to and through the site occupied by the Michoud Assembly Facility of the National Aeronautics and Space Administration (NASA) (See plate 1.) Under the project plan covered herein, the existing levee will be raised from its present grade which averages about 13 feet to net grades of 14 and 18.0 feet, respectively, west and east of Paris Road. The plan provides for constructing approximately 8 miles of levee enlargement, 1 mile of floodwall (I-type and inverted T-type), foreshore wavewash protection, 3 gap closure gates, and the relocation of 2 roads, drainage ditches, nitrogen transmission pipelines, a culvert, 5 electrical conduits, 1 oil pipeline, and 14 waterlines.

DEPARTURES FROM PROJECT DOCUMENT PLAN

17. Departures from the project document plan. a. General. The plan presented herein is generally the same as that presented in the authorizing document. The following changes, which are within the discretionary authority of the Chief of Engineers, have been incorporated into the plan.

(1) Grade revisions. The net grades of most of the protective structures included in the plan were revised upward by 1 to 2 feet in accordance with the results of tidal hydraulic studies utilizing more severe hurricane parameters developed by the U. S. Weather Bureau subsequent to project authorization. Partial results of these studies are contained in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I - Chalmette" dated 18 August 1966, approved 27 October 1966, and "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part II - Barrier" submitted and currently under review. The remaining results of tidal hydraulic studies pertinent to the Lake Pontchartrain Barrier Plan will be reported in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part III - Lakeshore" which is scheduled for submission in July 1968. A comparison of the revised net grades and those contained in the authorizing document is shown in table 1.

(2) Modification in barrier alignment. The alignment of the Lake Pontchartrain Barrier between New Orleans East and a point just east of Chef Menteur Pass was modified to relocate the embankment seaward of an expanding prestige-class residential and commercial development located between the eastern limit of the existing levee system and Chef Menteur Pass. Bases and justification for this modification are contained in LMNED-PP letter dated 13 March 1967, subject "Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier," copy of which is included herein as appendix C. The modification was approved by OCE on 15 May 1967.

(3) Modification in the controlling elevation of Seabrook Lock. In order to reduce levee grade requirements on the IHNC north of the L&N Railroad, and hurricane flood damage to industrial developments located on the bank of the IHNC canalward of the levees, by permitting some lakeward flow in the canal during certain types of hurricanes, the controlling elevation of the Seabrook Lock was changed from elevation 13.2 to elevation 7.2. Bases and justification for the change are contained in LMNED-PP letter dated 19 October 1966, subject "Lake Pontchartrain, La. & Vicinity - Reports on Controlling Elevation of Seabrook Lock," a copy of which is included herein as appendix E. The modification was approved by OCE on 12 January 1967.

TABLE 1
LAKE PONTCHARTRAIN BARRIER PLAN
NET GRADE REVISIONS

Levee or embankment	Net grade - feet	
	Revised	Project document
Citrus Back Levee		
West of Paris Road	14.0	13.0
East of Paris Road	18.0*	16.0
New Orleans East Back Levee	17.5	16.0
Inner Harbor Navigation Canal		
Seabrook to L&N RR	13.0 - 14.0	13.0
L&N RR to IHNC Lock	14.0	13.0
New Orleans East Lakefront Levee	12.0**	10.0
Citrus Lakefront Levee	13.0**	11.0
New Orleans Lakefront Levee	13.0**	11.5
Jefferson Lakefront Levee	10.0	10.0
St. Charles Parish Lakefront Levee	11.0**	10.0
Barrier Embankment	9.0***	9.0
South Point to GIW Levee	11.6**	11.6

*Grade is 0.5 foot higher than grade computed in DM No. 1 - Part 1 - Chalmette. This minor difference in grade is due to a difference in configuration of the levee cross sections used in this memorandum as compared with the configuration used in DM No. 1 - Part I - Chalmette. The configuration used herein is based on detailed soils data and studies not available at the time DM No. 1 - Part I - Chalmette was prepared and is the optimum configuration insofar as levee cost is concerned.

**Tentative pending approval of DM No. 1, Part III - Lakeshore.

***Tentative pending approval of DM No. 1, Part II - Barrier.

(4) Foreshore protection. (a) General. In the project document, the cost for levee foreshore protection along the MR-GO and the GIW was included with the portion of the project costs to be distributed in accordance with the 70%-30% formula specified in the authorization. By 1st Indorsement to LMVD letter dated 21 March 1966, subject "Hurricane Protection - Lake Pontchartrain, La. and Vicinity - Chalmette Area," the Chief of Engineers directed that the costs for foreshore protection be charged to navigation rather than hurricane flood control. This directive was amplified and clarified by OCE in 1st Indorsement to LMVPD letter dated 24 April 1967, subject "Hurricane Protection - Lake Pontchartrain and Vicinity." Specifically, OCE concluded that the levee foreshore protection along the MR-GO is properly a feature of the Mississippi River-Gulf Outlet project, and the costs for such protection are, in their entirety, chargeable to that project. OCE concluded further that the levee foreshore protection, required along the GIW, is properly a feature of the "Lake Pontchartrain, La. and Vicinity," project and hence is subject to the 70%-30% cost sharing. The PB-3's for the two projects have been revised accordingly, draft letters notifying the Public Works and Appropriations Committees of the Congress of the change have been forwarded to higher authority, and a supplement to the general design memorandum for the MR-GO detailing the change is being prepared.

(b) Citrus Back Levee. The Citrus Back Levee is adjacent to the MR-GO from station 176+75.9 to station 507+44.6, adjacent to the GIW from station 507+44.6 to station 570+73.3 and adjacent to the Michoud Canal from station 570+73.3 to station 664+73.3. Notwithstanding the fact that design memorandum coverage of all levee foreshore protection along the MR-GO is to be provided in a supplement to the general design memorandum for that project, the design for all foreshore protection required in connection with the Citrus Back Levee is developed herein in view of the rather intimate relationship between the levee and the foreshore work which will serve to preserve its integrity. Costs for all foreshore protection along the Citrus Back Levee are likewise presented in the detailed estimates; the costs for foreshore protection are, however, included as an independent item, and the costs for foreshore protection along the MR-GO are excluded from the summary estimates for the Citrus Back Levee and the Lake Pontchartrain Barrier Plan.

b. Citrus Back Levee. Other than the upward revision in net grades described in subparagraph a. above, and the substitution of floodwall for levees in areas where existing development renders levee construction impracticable, and/or uneconomical, there are no significant changes in the project document plan for the Citrus Back Levee.

HYDROLOGY AND HYDRULICS

18. General. The Hydrology and Hydraulic Analysis Design Memorandum for the Lake Pontchartrain Barrier Plan is being presented in a series of three separate reports subtitled Part I - Chalmette, Part II - Barrier, and Part III - Lakeshore, respectively. Part I - Chalmette was approved on 27 October 1967, Part II - Barrier is currently under review by higher authority, and Part III - Lakeshore is scheduled for submission in July 1968. These documents present detailed descriptions and analyses of the tidal hydraulic methods and procedures used in the tidal hydraulic design of the features of the plan, and include the essential data, assumptions, and criteria used, and results of studies which provide the bases for determining surges, routing, wind tides, runup, overtopping, and frequencies. All basic hydraulic information required for design of the Citrus Back Levee is contained in Part I - Chalmette, which has been approved.

19. Design elevations. The design hurricane for the Citrus Back Levee is the standard Project Hurricane (SPH) having a frequency of about once in 200 years; a central pressure index of 27.6 inches of mercury; a maximum 5-minute average wind velocity of 100 m.p.h. 30 feet above ground level at a radius of 30 nautical miles from the center; a forward speed of 11 knots; and a track critical to the area in question. Detailed information on the design hurricane is contained in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I - Chalmette." The design hurricane will produce a maximum wind tide level of 13.0 feet along the alignment of the Citrus Back Levee. From the IHNC to Paris Road, waves are not a factor and 1 foot of freeboard was added to the wind tide level to produce a net grade of 14.0 feet. From Paris Road east, wave action will occur, and an allowance of 5.0 feet was provided for wave runup, yielding a net grade of 18.0 feet. This grade is 0.5 foot higher than the preliminary grade computed in Design Memorandum No. 1 - Part I - Chalmette. The increase is a result of adoption, based on soils studies and comparative cost estimates, of a levee cross section configuration different than that used in Design Memorandum No. 1 - Part I - Chalmette. The design elevations for the remainder of the barrier plan are covered briefly in subparagraph 17.a.(1).

20. Drainage. a. General. With the exception of the St. Charles Parish area, all of the protected areas of the Lake Pontchartrain Barrier Plan are presently enclosed by levees and provided with drainage systems. The authorized plan for St. Charles Parish includes only a main collector canal and a gravity outlet through the levee; local interests must provide the remainder of the system as an item of local cooperation. Insofar as the project is concerned, work related to drainage in other areas of the Lake Pontchartrain Barrier Plan will be limited to modifications of the existing system to accommodate the hurricane protective works. Detailed coverage of these modifications, and for any drainage works required in the St. Charles Parish area, will be included in the various supplements to this memorandum.

b. Citrus Back Levee. Inasmuch as an existing system of levees completely encompasses the Citrus area, as shown on the fly-leaf map, interior drainage is required to prevent flooding of the developed areas as a result of direct rainfall. Local interests have provided the required drainage. Existing pump discharge pipes will be modified to pass through the floodwall. A relocated drainage ditch between stations 495+19 and 571+55 and 582+44 and 625+77 will be constructed and/or reshaped to provide sufficient area for construction of the levee enlargement. The plan presented herein is merely an enlargement of the existing Citrus Back Levee, and will not interfere with the existing interior drainage facilities.

GEOLOGY

21. Physiography. The proposed project area[1] is located within the central Gulf Coastal Plain. Specifically, the project area, known as the Pontchartrain Basin, is located on the eastern flank of the Mississippi River Deltaic Plain between the alluvial ridge of the present Mississippi River and the uplands to the north and west. Dominant physiographic features of the area are marshes, natural levees, abandoned distributaries, and lakes. Relief in the project area is slight with a maximum variation of about 12 feet occurring in St. Charles Parish between the natural levee ridge of the present Mississippi River and the marshes adjacent to Lake Pontchartrain. Maximum elevations of about 12 feet are found along the crest of the natural levee ridge flanking the Mississippi River just above New Orleans. Minimum elevations of about -4 to -6 feet are found in the artificially drained lowlying marsh and swamp areas. A low remnant alluvial ridge (Metairie Ridge) with elevations of 2 feet to 4 feet, marking the position of an ancient distributary of the Mississippi River, extends east-northeastward through New Orleans forming a smaller subbasin between the ridge and the present Mississippi River natural levee ridge.

22. General geology. During the Brydan (Peorian) Interglacial stage, the Pleistocene Prairie Formation was deposited over the project area in the form of a huge delta, centered in southwest Louisiana.

23. When sea level began to fall in the early part of the Late Wisconsin glacial stage, the Mississippi River and the smaller streams began to entrench into the Prairie surface. By the end of the Pleistocene Epoch (and Late Wisconsin glacial stage), with sea level about 450 feet below its present level, the Mississippi River

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[1] As used herein, the term "project area" refers to the area subject to the influence of hurricane-generated tidal surges.

had become deeply entrenched to the west of the project area. The Prairie surface in the project area remained relatively undissected as a shelf on the northeast side of the Mississippi River trench. During this period, the sediments on this high shelf were weathered and desiccated.

24. As sea level rose, the Mississippi River began to aggrade the deep trench cut when sea level dropped. Alluvial sedimentation was confined to the central portion of the alluvial valley and the project area (Pontchartrain Basin) became a shallow arm of the gulf, or a huge bay. Concomitantly, downwarping of the Prairie surface and some faulting along the northern edge of Lake Pontchartrain occurred, resulting in a gulfward dip of the Prairie surface of about 1.6 feet per mile in the project area. Two prominent beaches began to develop as sea level neared its present level - one on the northern side of Lake Pontchartrain about 5 to 6 miles south of the present north shoreline (Mandeville), the second one along the south shore of Lake Pontchartrain from the vicinity of Pearl River to the vicinity of New Orleans (the Pine Island Beach Trend).

25. About 5,000 years ago, sea level reached its present stand and the Mississippi River filled its entrenchment and began to migrate laterally back and forth across the deltaic plain. Approximately 4,500 to 4,000 years ago, the first Recent deltaic and alluvial sediments of consequence were carried into the project area when the Mississippi River occupied the Cocodrie Course. About 3,500 years ago, the Mississippi shifted its course over to the western margin of the valley and occupied the Teche course until about 2,800 years ago. During this period, the project area was subjected to erosion and subsidence. Several relic beaches were formed in the project area around the margins of the deteriorating Cocodrie Delta, the most continuous one being a shell beach paralleling the south shore of Lake Pontchartrain between the shoreline and the relic Pine Island Beach Ridge. When the Mississippi abandoned its Teche course, it shifted eastward and began to occupy the LaLoutre or St. Bernard course. Several distributaries of this system traversed the project area, the remnant natural levee ridges of which are found in several locations. The most prominent of these remnant alluvial ridges - the Metairie-Bayou Sauvage Ridge - extends east-northeastward through New Orleans to the vicinity of Chef Menteur Pass. About 1,500 years ago, the river shifted westward again and occupied the Lafourche course and for a period of several hundred years the project area was not subjected to sedimentation. When the Mississippi River shifted eastward about 1,200 years ago and began to occupy the present Plaquemine course, sediments were again introduced into the project area but in lesser quantities than had been carried in by previous courses. No large distributaries flowed into the project area and sediments consisted primarily of those brought in by overtopping of the natural levees along the Mississippi River. The main center of deposition shifted southward of the project area. With the construction of the

levees along the Mississippi River, floodwaters have been eliminated from the region and at present no sediments are being introduced into the project area.

26. Subsidence. Progressive subsidence and downwarping have been occurring in the project area since the end of the Pleistocene. The Pleistocene surface has been downwarped towards the south and west from zero at the Pleistocene outcrop on the north side of Lake Pontchartrain to about 500 feet at the edge of the continental shelf about 80 miles south of New Orleans. The overall rate of subsidence in the project area has been about 0.39 foot per century. In addition, large settlements of the ground surfaces have occurred in the marsh and swampland areas, a result of the shrinking of the highly organic surface soils as the land was reclaimed and drained.

27. Investigations performed. General-type and undisturbed type borings, penetrating the Prairie surface, were made in conjunction with the project. In addition, geologic information from other sources was available for the interpretation of the physiography, subsurface, and foundation conditions of the area.

28. Foundation conditions. The subsurface, as shown on plates 32 through 36, consists of Recent deposits varying in thickness from zero at the Pleistocene outcrop on the north shore of Lake Pontchartrain to about 80 feet at the Mississippi River end of the Inner Harbor Navigation Canal. Several exceptions to this maximum depth are found within the project area; the most notable are in the vicinity of U. S. Highway 90 where an ancient distributary (the Metairie distributary) has incised deeply into the Pleistocene, and in the vicinity of the MR-GO and the IHNC where an ancient channel or reentrant filled with Recent sediments exists on the Pleistocene surface. Underlying the Recent are deposits of Pleistocene age (Prairie Formation). Generally, in the marsh and swamplands between the buried sand beaches and the natural levee crests, and along the St. Charles-Jefferson Parish lakeshore, the Recent consists of a 4- to 18-foot layer of very soft marsh clays with organic matter. In the western portion of the project area, the marsh deposits are underlain by very soft lacustrine clays overlying bay-sound silts and silty sands. Towards the central portion of the project, the marsh deposits are underlain by very soft to soft interdistributary clays which overlie medium to stiff prodelta clays; estuarine clays, silts and sands; and nearshore-gulf sands and silty sands with shells and shell fragments. In the eastern portion of the project area, the marsh deposits are underlain by soft intradelta clays and silts and interdistributary clays which overlie bay-sound and stiff Pleistocene deposits. The bay-sound, prodelta, estuarine, and nearshore-gulf deposits lie unconformably over the Pleistocene. Along the existing natural levees of the Mississippi River and the remnant natural levees of ancient distributaries, medium to stiff natural levee clays with layers and lenses of silt throughout are encountered at

or near the surface of the Recent. Parallel to the south shore of the lake from the vicinity of the Jefferson-Orleans Parish line to the Chef Menteur Pass a 10- to 40-foot thick buried beach deposit of fine sand with shell and shell fragments exists. The Pleistocene deposits that underlie the Recent and form the uplands north of the lake consist predominately of stiff to very stiff oxidized clays with local zones and strata of silts and sands.

29. Mineral resources. Oil and gas production are found in the project area, and future exploration and production may take place. The project is not anticipated to adversely affect existing or future exploration and production.

30. Conclusions. The low shear strength of some of the Recent materials and the high compressibility of some of these sediments, particularly the marsh, interdistributary and lacustrine deposits, will result in major stability and settlement problems. The existence of large sand and silt layers and their proximity to the surface, particularly along the south shore of the lake and in the vicinity of the Rigolets, will result in seepage and uplift problems and necessitate relief systems. In addition, levees constructed adjacent to Lake Pontchartrain will be subject to wave erosion and levees constructed along navigable waterways, i.e., those adjacent to the MR-GO and GIW will be subjected to waves generated by waterborne traffic and will require wavewash foreshore protection.

SOILS AND FOUNDATIONS INVESTIGATION AND DESIGN

31. General. This report covers the soils and foundation investigation and design for the Citrus back leveeand floodwalls located along the north banks of the MR-GO and the GIW extending from the IHNC through the NASA complex. Soils and foundations coverage for other features of the Lake Pontchartrain Barrier Plan will be included in the various supplements to the design memorandum.

32. Field investigations. Four 5-inch diameter undisturbed soil borings were made along the levee alignment. Two were made in the levee reach west of Paris Road and two in the levee reach east of Paris Road. Fifteen 1-7/8-inch I.D. general-type core borings were made along the levee alignment, 6 west of Paris Road, and 9 east of Paris Road. The borings were made at intervals varying from about 1,600 to 4,800 feet along the project alignment at selected locations. The borings extended in depth to elevations -50 to -70. The locations of the borings are shown on plates 2 through 5.

33. Laboratory tests. Visual classifications were made on all samples obtained from the borings. Water content determinations were made on all cohesive soil samples. Consolidation (C) tests, Unconfined Compression (UC), Unconsolidated-Undrained (Q), Consolidated-Undrained (R), and Consolidated-Drained (S) shear tests were performed

on representative soil samples from the undisturbed borings. The locations and results of the tests are shown on plates 2 through 5 and plates 54 through 57.

34. Soil conditions. The subsurface along this project[1] consists generally of 10 to 15 feet of artificial levee fill overlying 45 to 60 feet of Recent deposits of clays, silts, and sands which are underlain by a Pleistocene deposit encountered at elevations -50 at the west end of the project and -60 at the east end of the project. A generalized soil and geology profile is shown on plate 35. The portion of the subsurface soils above the Pleistocene deposit, which directly affects the design of this project, consists generally of the following:

35. Station 176+75.87 (west end of the project) to station 415+00 (vicinity of Paris Road). This reach is predominately soft to stiff clay fill down to elevations varying from -5 to -8 underlain by a 5- to 10-foot layer of soft organic clay which overlies soft to medium clays extending down to elevations varying from -40 to -45 where a 5- to 15-foot layer of fine sand overlies the Pleistocene deposit.

36. Station 415+00 to station 481+00. This reach is predominately soft to stiff clay fill down to approximate elevation -3 underlain by a 10- to 20-foot layer of soft to medium fat clay which overlies a stratified layer of silts and lean clays extending down to varying elevations of -30 to -40 where a 7- to 20-foot stratified layer of fine sands and medium clays overlies the Pleistocene formation.

37. Station 481+00 to station 495+00. This reach is predominately medium to stiff clay fill down to approximate elevation 0.0 underlain by a 10-foot layer of soft to medium organic clay which overlies an abandoned distributary of silts and sands overlying the Pleistocene formation.

38. Station 495+00 to station 550+00. This reach is predominately soft to medium clay fill down to approximate elevation -3 underlain by a 5 to 10-foot layer of soft to medium organic clay which overlies a stratified layer of silts and soft to medium clays extending down to the top of the Pleistocene formation.

39. Station 550+00 to station 580+00. This reach is predominately soft to medium clay fill down to approximate elevation -3.

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[1] As used in this section, the term "project" refers to the Citrus Back Levee.

Below the clay fill is a 10-foot layer of soft organic clay which overlies a 10-foot layer of soft to medium fat clay. Below the layer of fat clay is a 10-foot layer of fine sand overlying a medium clay layer extending down to the top of the Pleistocene formation.

40. Station 580+00 to station 650+00. This reach is predominately soft to medium clay fill down to approximate elevation -4.0. Below the clay fill is an 8-foot layer of soft to medium organic clay underlain by 10 feet of stratified layers of silts and lean clays. Below the layers of silts and lean clays is a 5- to 10-foot layer of fine sand which overlies a medium fat clay layer extending to the top of the Pleistocene formation.

41. Station 650+00 to station 664+73.3 (east end of project). From the surface to elevation 0.0, this reach consists of a medium to stiff clay fill underlain by a 10-foot medium fat clay layer. Below the fat clay layer is 10 feet of stratified layers of silts and lean clays which overlies soft to stiff clays extending to the top of the Pleistocene formation.

42. Water contents of soils. The range of water contents for the clays and organic clays is as follows: fill, 25 to 90 percent; organic clays, 150 to 450 percent; Recent clays between the organic clays and above the nearshore gulf sands, 45 to 80 percent; and the Pleistocene clay about 40 percent or less.

43. Design and construction problems. The low shear strengths of the Recent foundation clays, the proximity of the existing canals, the numerous facilities, existing interior drainage, and pipe crossings all combine to produce major design and construction problems in the following areas of interest:

a. Types of protective works
b. Location of protective works
c. Stability
d. Floodwall type
e. Settlement
f. Sources of fill material
g. Methods of construction
h. Erosion protection

44. Types of protective works. Conventional earthen levees will be used along the project alignment except at facility crossings. At the bulk loading plant (station 253+35 to 271+55) and at the facility crossings (station 430+95 to 454+85 and station 571+55 to 584+23.6) east of Paris Road, I-type walls will provide the protection except that T-walls will be used at the bulk loading facility pumping station.

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45. Location of protective works. The protective works for this project are located to provide adequate stability with respect to assumed failure into the bordering canals and channels. The project alignment is shown on plates 2 through 5. Specific data relative to the location and type of protective works are listed in table 2.

46. Stability - Cantilever I-type floodwalls. The stability and the required penetration of the steel sheet pile below the earth surface were determined by the method of planes using the (S) shear strengths shown on the stability plates. A factor of safety of 1.5 was applied to the design shear strengths as follows:

$$(c=o): \quad \phi \text{ developed} = \tan^{-1}\left(\frac{\tan \phi \text{ available}}{\text{factor of safety}}\right).$$

Using the resulting shear strengths, net horizontal water and earth pressure diagrams were determined for movement toward each side of the sheet pile. Using these distributions of pressures, the summation of horizontal forces was equated to zero for various tip penetrations. At these penetrations, summations of overturning moments about the bottom of the sheet pile were determined. The required depths of penetration were determined as those where the summation of moments was equal to zero.

47. Sufficient (Q) stability analyses were performed to confirm that the (S) case governed for design. These analyses are shown on plate 46.

48. Wave forces are not a design factor in the reach west of Paris Road and the I-walls were designed for a static water level at elevation 14.5, which is 6 inches below the top of the wall. These analyses are shown on plate 38.

49. Dynamic wave forces are a design factor in the reach east of Paris Road. The results of hydraulic analysis indicate that the walls will be subjected to the pressures and forces imparted by a "broken wave." One percent of the waves will be equal to or larger than the magnitude of the design wave. The heights of these maximum waves range from 7.9 to 8.9 feet and a design wave crest elevation of 18.8 was used in the stability analyses for determining static water pressures. Required penetrations of the sheet pile, with a factor of safety of 1.5 with respect to the (S) shear strengths, were determined at representative sections along the recommended wall alignment. These analyses are shown on plates 48 through 50. To determine the effect of the dynamic action of the design wave on the wall stability, the dynamic action was applied as a line force acting through the centroid of the dynamic wave action distribution diagram superimposed on the static water pressure distribution (see Fig. D-6, appendix D). It was considered that the time of action of the

Par 45.

TABLE 2
LOCATION AND TYPE OF PROTECTIVE WORKS

Station location	Elevation (m.s.l.) Top elevation: Levee	Wall	Sheet pile tip: I-wall	T-wall	Stability analysis plate No.
176+76.9 to 253+40	14.0	-	-	-	37
253+35 to 255.10	9.0	15.0	-9.5	-	38
255+10 to 255+90	9.0 to 11.0	15.0	-	-9.5	43
255+90 to 256+44	9.0	15.0	-9.5	-	38
256+44 to 256+68	Ramp	-	-	-	52
256+68 to 271+55	9.0	15.0	-9.5	-	38
271+50 to 417+75	14.0	-	-	-	37
417+75 to 421+75	14.0 to 18.0	-	-	-	-
421+75 to 431+00	18.0	-	-	-	39
430+95 to 432+00	18.0 to 13.0	20.0	-5.0	-	-
432+00 to 439+44	13.0	20.0	10.0	-	44 - 50
439+44 to 439+88	Gate	20.0	-	-10.0	43
439+88 to 442+41	13.0	20.0	-10.0	-	44 - 50
442+41 to 442+85	Gate	20.0	-	-10.0	43
442+85 to 447+01.9	13.0	20.0	-10.0	-	44 - 50
447+01.9 to 447+46	Gate	20.0	-	-10.0	43
447+46 to 454+62	13.0	20.0	-10.0	-	44 - 50
454+62 to 454+(85)80	13.0 to 18.0	20.0	-5.0	-	-
454+75 to 494+00	18.0	-	-	-	39 and 40
494+00 to 494+40	Ramp	-	-	-	53
494+40 to 571+60	18.0	-	-	-	40 and 41
571+55 to 571+60	18.0	22.0	-5.0	-	-
571+60 to 572+08	18.0 to 13.0	22.0	-10.0	-	-
572+08 to 582+96	13.0	22.0	-10.0	-	46 and 51
582+96 to 584+23.6	13.0 to 18.0	22.0	-5.0	-	-
584+18.6 to 664+73.3	18.0	-	-	-	40 - 42

dynamic design wave force against the wall was insufficient to significantly change the slopes of the lateral earth and water pressure distrubution diagrams of the static water level analysis. Accordingly, required penetrations of the sheet pile were determined, with a dynamic wave force, for factors of safety of 1.0, 1.25, and 1.5, with respect to shear strength. These analyses are shown on plate 47.

50. The existing levee crown within the recommended I-wall reach varies from about elevation 11.0 to elevation 13.5. Initially, stability analyses were performed with no dynamic wave force, for a limiting minimum crown elevation of 12.0, and for existing crown elevations of 12.0 to 13.5 (see plates 44, 45, and 46). However, the levee crown will be constructed to a minimum elevation of 13.0. Since the stability analyses show that the penetrations required for the dynamic design wave force, with a factor of safety of 1.25, are greater than those required for the design wave static water level, with a factor of safety of 1.50, the former penetrations are considered acceptable for design purposes. Based on the foregoing, with the levee crown at elevation 13.0 and the wave berm shown on the stability sections, the required elevation of the tip of the sheet pile in the I-wall east of Paris Road is -10.0.

51. Stability. a. Levees. Using cross sections representative of existing conditions along the protection alignment, the slope and berm distances for the recommended levees were designed for the following conditions: hurricane water condition at still water level (elevation +13.0) for the project hurricane and assumed failure toward the landside; mean low water on the canalside and failure to the canalside; and maximum drawdown due to interior drainage on the landside and assumed failure toward the landside. The stability of the levee was determined by the method of planes using the design (Q) shear strengths shown on the stability plates and applying a minimum factor of safety with respect to strength of approximately 1.3. These analyses are shown on plates (38) through 42 and 48 through 51.
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b. Road ramps. The ramps at the bulk loading facility and at the NASA dock were investigated for mass stability by applying the method of planes analysis to an equivalent cross section normal to the assumed failure mass, projected in plan. The live loads on the bulk loading facility ramp were not a design factor. The live loads on the NASA dock ramps, however, were of sufficient magnitude to affect the design. Based on data furnished by NASA, the effect of vehicular loads on the assumed failure mass was taken into account in the stability analysis. The ramp stability analyses are shown on plates 52 and 53.

52. Floodwall type at facility crossings. Space limitations precluded the use of conventional levees at the facility crossings. The type of floodwall used was based on stability, settlement, and wave force requirements. I-type walls were found to be satisfactory in all

locations except at the pumping station serving the bulk loading facility between station 255+10 and station 255+90 where space limitations preclude construction of the embankment required with the I-type wall, and T-type wall on bearing piles must be used. A steel sheet pile cutoff will be used beneath the T-wall to provide protection against seepage.

53. Foundations for structures. Twelve-inch square prestressed concrete piles will be used to support the T-type walls and gated structures. Design bearing and tension capacities versus tip elevations for treated timber and 12-inch square concrete piles were determined for four representative foundation conditions along the project alignment. Design data were determined for the (Q) and (S) shear strengths, disregarding the skin friction above elevation -13.0. In compression, a factor of safety of 1.75 was applied to the shear strengths and a conjugate stress ration (k_o) = 1.0 was used in the (S) case for determining the normal pressure on the pile surface. In tension, a factor of safety of 2.0 was applied to the shear strengths and a (k_o) = 0.7 was used in the (S) case. The (S) case governed for design and the results are shown on plate (47). Bearing pile tip elevations used for cost estimating purposes are shown on plates 23 and 28. 43

54. Settlement. Based on foundation conditions determined from the soil borings and consolidation test data from the undisturbed borings, estimates of settlement beneath the levees along the line of protection were made. The settlements estimated for levees containing sheet pile walls indicate that the proposed wall construction grades are sufficient to provide ultimate protection to design net grade. However, some settlement will occur beneath canalside wave runup berms and these berms will be overbuilt 1 foot above net grade to compensate for future settlement. Estimated ultimate settlements, including settlement during construction, of the conventional levees to be constructed along the project alignment are shown in table 3.

55. Sources of fill material. In the reach between the Inner Harbor Navigation Canal east levee and Paris Road, the existing levee was recently raised (1966) by local interests in a landside enlargement, under their program to enhance the degree of protection for Orleans Parish during the interim period while the Federal project is being designed and constructed. The fill for completing the levee portion of the project will be obtained from adjacent borrow and, if required, from a borrow area in the bottom of Lake Pontchartrain along the north shore. The borrow material from the lake, consisting of stiff Pleistocene clays, will be transported to the project on barges.

TABLE 3
Settlement During Construction
for Citrus Back Levee

LEVEES WEST OF PARIS ROAD

Lift No.	Type	Time (Yrs.)	Elev.(1) (m.s.l.) Crown	Base	Settlement (Ft.) Crown	Base
		0	5.0	1	0	0
1	0 + con.		14.0	0.5	0	0.5
	cast	1	12.0	-1.5	2.0	2.5
2	1 + con.		14.0	-2.0	2.0	3.0
		3	12.0	-3.5	4.0	4.5
3	3 + con.		14.0	-3.7	4.0	4.7
	hauled	5	13.0	-4.2	5.0	5.2
	5 + con.		14.0	-4.2	5.0	5.2
		7	13.5	-4.5	5.5	5.5
Maintenance thereafter						
		East of Paris Road (Levees)				
		0	2.0	2.0	0	0
1	0 + con.		18.0	1.0	0	0
	cast	1	14.5	-1.0	3.5	3.0
2	1 + con.		18.0	-1.5	3.5	3.5
		3	15.0	-4.0	6.5	6.0
3	3 + con.		18.0	-4.3	6.5	6.3
		5	16.8	-5.5	7.7	7.5
4	hauled 5 + con.		18.0	-5.5	7.7	7.5
		7	17.5	-6.0	8.2	8.0
Maintenance thereafter						
		(Ramp)				
		0	2.0	2.0	0	0
1	0 + con.		18.0	1.5	0	0.5
		1	16.5	0.0	1.5	2.0
2	1 + con.		18.0	-0.3	1.5	2.3
		3	16.5	-1.5	2.7	3.5
3	3 + con.		18.0	-1.7	2.7	3.7
		5	17.0	-2.5	3.5	4.5
4	5 + con.		19.0	-4.0	5.0	6.0
Maintenance thereafter						

(1)Gross yardage including estimated settlements was used in computing construction costs for the levees and ramps.

56. Method of construction. Between the IHNC and Paris Road the levees will be built with material cast from adjacent borrow. In the reach east of Paris Road, where adjacent borrow is not available, the levee will be built with material hauled from stockpile areas or transported on barges from the bottom of Lake Pontchartrain along the north shore. Stage-construction methods will be used to compensate for settlement. The sequence of construction is as follows: In those areas where walls tie into levees, the fill will be placed as required on the existing levee prior to construction of the walls and for a distance of 50 feet beyond the end of the I-type walls to reduce the ultimate settlement of the walls. The levees and berms will be constructed to full net grade and section with construction of the berm preceding levee construction. The levees and berms will be maintained to net grade and section by succeeding construction stages as settlement ensues.

57. Erosion protection. Due to the short duration of hurricane flood stages and the resistant nature of the clayey soils, no erosion protection is considered necessary on the levee slopes along most of the alignment. One area along the Michoud Canal, however, experienced extensive damage from severe wave attack during hurricane Betsy. The canalward levee slope in this area will be protected with riprap from elevation -3 to elevation 8.5 (See plates 9 and 42.) Foreshore protection will be provided along the top of the canal bank along the entire alignment (station 176+75.9 to station 664+73.3) to provide protection against erosion from traffic-generated waves. This protection will consist of a layer of riprap on a 3/4-foot thick shell blanket and extending from elevation 3.0 to -3.0 (See plates 6 through 12.)

58. Settlement observations. Settlement observations will be made along the floodwalls promptly after construction and yearly thereafter until settlement is essentially complete. Profiles and sections will be obtained along the entire alignment before initiating construction, during construction of each stage of the levees and berms, and annually after completion of the last stage until settlement is essentially complete.

59. Additional soils borings and tests. In order to insure an adequate design and provide assurance against major construction failures, additional soils borings and tests will be made in the intervals between successive construction lifts. Supplemental design analyses utilizing the information obtained will be made and preparation of plans and specifications for each construction lift will be based on these analyses. The analyses will be submitted for approval either prior to or concurrent with submission of the plans and specifications, as appropriate.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

GENERAL

60. This memorandum contains detailed descriptions of the Citrus Back Levee only. While the cost estimates contained herein for other elements of the Lake Pontchartrain Barrier Plan are based generally on survey report escalations, the estimates for levee costs have been revised to reflect the higher net grades tabulated in paragraph 17, and, in some cases, revised cross sectional configurations based on additional soils information obtained subsequent to the preparation of the survey report. Typical levee cross sections utilized in preparing these cost estimates are shown on plates 6 through 12.

LEVEES

61. The general location of the Citrus Back Levee is shown on plate 1 and the detailed alignment and profile are shown on plates 2 through 5. The levee is located on the north bank of the MR-GO and GIW and extends from the IHNC through the NASA complex.

62. The project plan consists of levee enlargement and/or floodwall construction along the existing levee alignment. Floodwalls will be constructed at three locations (station 253+35 to station 271+55, station 430+95 to station 454+80, and station 571+55 to station 584+23.6) where congested commercial development renders levee construction impracticable and/or uneconomical. Total length of the levee and floodwalls is 9.2 miles. The description of floodwalls and the embankments in which they are located is contained in Paragraphs 68 through 71.

63. The primary source of borrow for levee construction will be the beds of the MR-GO and GIW. In addition, material for levee construction will be obtained from construction of relocated drainage ditches between stations 495+19 and 571+55, and 582+44 and 625+77, from the existing levee between stations 454+75 and 507+00 and stations 584+18.6 and 664+73.3, and from the bottom of Lake Pontchartrain along the north shore in the vicinity of Interstate Highway No. 10.

64. Between stations 176+75.9 and 255+10, stations 271+55 and 432+75, and 507+44.6 and 571+60, the levee will be constructed to final grade and section in four lifts with intervals of approximately one year between successive lifts. Material for the first two lifts will be obtained from the beds of the MR-GO or the GIW, as applicable. Material for the third and fourth lifts will be obtained from the borrow area in Lake Pontchartrain and transported to the construction site by barge. Casting equipment will be used, and the final lift will be overbuilt to compensate for ultimate settlement and shrinkage.

65. The levee between stations 455+57 and 507+44.6, and 584+13.6 and 664+73.3, will be constructed to final grade and cross section in four lifts, with a waiting period of 1 year between lifts. The first lift will be constructed largely with material from the aforementioned Lake Pontchartrain borrow area, except that spoil from the drainage ditch relocations between stations 495+19 and 571+55 and stations 582+44 and stations 625+77 will be utilized where practicable. The second lift borrow will, for the most part, come from the Lake Pontchartrain borrow area, with material from the existing levee used to supplement this source when practicable. Material for the third and fourth lifts will be obtained from the borrow area in Lake Pontchartrain and transported to the construction site by barge. Inasmuch as no exposed borrow areas are involved in construction of the levee, beautification measures will be limited to observance of proper "housekeeping" during construction and subsequent cleanup, and the grading and sodding of the finished levee, which will be included as items of work in the construction contracts. Construction plans and specifications will contain provisions relative to water quality degradation during construction, the accidental spillage of petroleum products or other harmful materials, and maintenance of adequate sanitary facilities to treat domestic wastes.

ACCESS ROADS

66. Access roads. Access to the Citrus Back Levee is provided by Louisiana State Highway 47 (Paris Road), over local roads leading to the levee at the west end of the levee, at the bulk loading facility, and through the NASA facilities. Existing access to the levee is considered adequate for the type and quantity of construction equipment needed for construction of the levee. The new Paris Road bridge over the MR-GO will replace a portion of the existing Paris Road, which crosses the levee. Removal of the pontoon bridge across the MR-GO will render the existing Paris Road useless and, therefore, no special construction across the road is necessary. A ramp will be constructed at this location, however, to provide access to the levee for construction and subsequent maintenance. Access for the floating plant required for construction will be by the MR-GO, the GIW, the Michoud Slip and the Michoud Canal. Use of the waterways adjacent to the levee for construction purposes is expected to present no problems. The crown of the final levee section will be used as an access road for maintenance purposes.

STRUCTURES

67. Criteria for structural design. The criteria and calculations for structural design of the floodwalls and gates are presented in appendix D.

68. Floodwalls. Floodwalls are required in three locations along the Citrus Back Levee. The first location is at the Bulk Loading Facility of the Board of Commissioners, Port of New Orleans. The floodwall will begin at station 253+35 and extend through the plant area to station 271+55. In this reach, except between stations 255+10 and 255+90, the existing levee will be raised by enlarging the cross section to provide a 10-foot crown at elevation 9.0 and constructing therein an I-type floodwall to a gross grade of elevation 15.0. The I-type floodwall will consist of steel sheet piling from elevation 10.0 to elevation -9.5 with a reinforced concrete upper portion, encasing the upper 3 feet of the steel sheet piling and extending above it to elevation 15.0. Between stations 255+10 and 255+90, where space limitations preclude the construction of the embankment required with I-type floodwall, inverted T-wall supported by concrete bearing piles will be provided. Alignment of this floodwall is shown on plates 13 through 15 and typical sections are shown on plate 28.

69. The second reach of floodwall will start west of the Paris Road bridge at station 430+95 and extend through the New Orleans Public Service, Inc. (NOPSI) Michoud Steam-Electric Generating Plant to station 454+80. The levee cannot be built to net grade under the bridge because the added weight would overload the existing bridge foundation. East of Paris Road, the cooling water intakes and outlet structures, and the emergency fuel tanks of the NOPSI installation make levee construction impracticable due to space limitation, and the exhorbitant cost of any practicable means for passing the intake and outlet works through a levee. Therefore, the existing levee will be raised by reshaping the embankment to elevation 13.0 and constructing an I-type floodwall to elevation 20.0. Since the wall is subject to wave action a berm will be constructed on the canalside of the levee to break the waves. A wave berm is not required at the cooling water intakes and outlets and behind the emergency fuel tanks, since these structures will themselves break the waves. This floodwall alignment is shown on plates 15 through 18, and typical levee and floodwall sections are shown on plates 30 and 31.

70. The third reach of floodwall will be located in the NASA plant along the Michoud Canal. The floodwall will begin near the junction of the Gulf Intracoastal Waterway and the Michoud Canal at station 571+55 just west of the NASA main pumping station. From this point to station 584+23.6, the existing levee will be reshaped to elevation 13.0 and an I-type wall constructed therein to elevation 22.0. The I-type wall will intersect the four discharge pipes from the pumping station serving the plant area and extend past the Chrysler High Pressure Testing Facility. Construction of a levee in this area would require relocation of the Testing Facility. The nature of the NASA operation is such that this facility is needed on a more or less continuous basis, and relocations would require complete reconstruction at a new site, with attendant excessive cost and

to some extent, loss of advantages inherent in the recent location. Alignment of the floodwall is shown on plate 20 and 21 and typical I-type wall and embankment sections are shown on plate 29.

71. After all settlement has occurred in the vicinity of the floodwalls, concrete edging sills will be cast on both sides of the wall to permit the grass to be neatly trimmed when the embankment is mowed.

72. Gates. Three gates will be provided in the floodwall alignment passing through the NOPSI electric generating plant. Gates 1 and 2, located between stations 439+44 and 439+88 and between stations 442+41 and 442+85, respectively, will provide access from the main plant on the landside of the wall to the intake water pumps on the canalside. Gate 3 located between station 447+02.9 and 447+46.9 will provide access from the main plant to a loading dock on the existing secondary levee which protects the emergency fuel tanks. Each gate will consist of a single leaf overhead roller gate riding on an I-beam suspended from a reinforced concrete beam supported by three concrete columns. Each opening will have a vertical clearance of 16 feet and a horizontal clearance of 20 feet. The top beam over the opening will be removable to permit the passage of over-height loads. A stop will be provided to restrain the gate against wind forces during closing operations. The locations of gates 1 and 2 and gate 3 are shown on plates 3 and 4, respectively. Details of the gates are shown on plates 23 through 25.

73. Based on instructions contained in the 2d and 3d Indorsements to LMNED-PP letter dated 13 March 1967, subject "Lake Pontchartrain, La. and Vicinity, Lake Pontchartrain Barrier Plan, Design Memorandum No. 2, General Advance Supplement, IHNC West Levee-IHNC Lock to Florida Avenue," a corrosion survey has been initiated to establish the nature and extent of cathodic protection required at the site. Upon completion of the survey and evaluation of the data obtained, a report embodying recommendations relative to corrosion control will be submitted for approval.

SOURCES OF CONSTRUCTION MATERIALS

74. Sources of construction materials. Information relative to materials sources is contained in Design Memorandum No. 12, "Sources of Construction Materials," dated 27 June 1966, approved 30 August 1966.

COORDINATION WITH OTHER AGENCIES

75. General. As previously mentioned, the State of Louisiana, Department of Public Works, was appointed project coordinator for the State by Governor McKeithen. This agency has functioned to coordinate the needs, desires, and interests of State agencies and the Corps of Engineers. The Orleans Levee District, which will provide the local cooperation for all features of the project other than those located in St. Bernard Parish, possesses an excellent engineering staff, and actively assisted in coordinating the project planning. The project plan presented herein is acceptable to both of the above agencies.

76. U. S. Department of the Interior, Fish and Wildlife Service. Extensive coordination with the U. S. Fish and Wildlife Service was accomplished during preauthorization studies and subsequent to authorization of the project. By letter dated 21 April 1967, the Regional Director, U. S. Fish and Wildlife Service, Atlanta, Georgia, was informed that preparation of a general design memorandum for the Lake Pontchartrain Barrier Plan was under way, apprised of the departures from the project document plan, and requested to furnish views and comments on the modified plan. In a report dated 21 June 1967, the Acting Regional Director states "The Bureau has no additional comments at this time on the various modifications of the Lake Pontchartrain Barrier Plan, as presented in your April 21, 1967 letter. Our views regarding these changes will be included in our letters of comment to accompany your supplements to the general design memorandum." Copies of the above letter and the Acting Regional Director's report are contained in appendix B.

77. U. S. Department of the Interior, Federal Water Pollution Control Administration. By letter dated 21 April 1967, the Regional Director, Federal Water Pollution Control Administration, was informed that preparation of a general design memorandum for the Lake Pontchartrain Barrier Plan was under way, apprised of the departures from the project document plan, and requested to furnish views and comments on the modified plan. The Regional Director requested, in his letter of response dated 23 June 1967, that consideration be given to the following:

a. Minimizing water quality degradation during construction.

b. Constructing and operating the control structures so as to insure that ecological conditions remain unchanged.

c. Precluding mosquito breeding problems caused by increasing the Lake Pontchartrain water level, as a result of the hurricane protection project, thus flooding the lowlands bordering the lake.

d. Minimizing the accidental spillage of petroleum products or other harmful materials and maintenance of sanitary facilities to adequately treat domestic wastes.

78. Provisions relative to water quality degradation during construction, control of accidental spillages, and maintenance of adequate sanitary facilities by construction contractors will be incorporated into the construction plans and specifications. The Seabrook Lock will be operated to provide a desirable salinity regimen in Lake Pontchartrain to the end that deleterious alterations in lake ecology will be avoided. The Regional Director has been advised of the action to be taken in connection with his comments. Copies of correspondence with the Regional Director are included in appendix B. With respect to the concern relative to mosquito breeding problems in the event that the average level of Lake Pontchartrain is raised, it is noted that the Lake Pontchartrain Barrier Plan will not result in any material increase in the average lake level, but will serve only to prevent uncontrolled increase in lake levels during hurricanes.

79. National Aeronautics and Space Administration (NASA). Approximately 18,300 linear feet of the Citrus Back Levee are located on lands which are part of the Michoud Assembly Facility of the National Aeronautics and Space Administration. The agency was desirous of having the levee encroach on its plant area as little as practicable, and at a meeting on 10 November 1966 requested that a seaward enlargement of the existing levee be considered in lieu of the planned straddle enlargement. An evaluation of this procedure was made and the agency informed by letter dated 15 February 1967 that additional costs estimated at $400,000 would result and that these costs would have to be borne by them. By letter dated 17 April 1967, NASA indicated that they were agreeable to the straddle enlargement and requested consideration of various factors in the design and construction of the levee in the facility area. The design presented herein has taken these factors into account. Copies of the above referenced letters are contained in appendix B. Coordination with this agency is continuing.

REAL ESTATE REQUIREMENTS

80. General. All rights-of-way for the Citrus Back Levee will be acquired by the Orleans Levee District and furnished without cost to the United States. There will be no acquisition by the United States.

RELOCATIONS

81. Levees. The existing ramp at the Bulk Loading Facility will be reconstructed over the protective works to provide access to the MR-GO loading facility. Also, the pumping station in the vicinity of the Bulk Loading Facility will be modified by construction of a sheet pile wall between the station and the protective works. Details of the modifications to the ramp and pumping station are shown on plate 52.

82. The 16-inch high pressure gas pipeline which parallels the levee alignment between approximate station 428+68 and 433+68 will be relocated towards the MR-GO approximately 50 feet to provide sufficient area for constructing the levee enlargement. The proposed alignment of the 16-inch gas pipeline is shown on plate 16.

83. The levee alignment in the vicinity of the NASA dock facilities crosses the asphalt road which connects the dock to the NASA plant. The elevation of the asphalt road at this location is approximately 12.0, which is 6 feet below the required net grade of the hurricane protection levee. Inasmuch as the NASA officials have requested that access to the dock not be interrupted, a portion of the asphalt road will be relocated north of the existing road and ramped over the protection levee at that location as shown on plate 19. In addition, a 6 inch water line, power lines, and telephone facilities, will be relocated as shown on plate 19.

84. The landside levee enlargement will extend into the drainage ditch paralleling the levee alignment between stations 495+19 and 571+55 and stations 582+44 and 625+77. Inasmuch as the drainage ditch is utilized by NASA as a ponding area, either a new drainage ditch will be provided or the existing ditch will be reshaped, as applicable, to provide the same ponding area as the existing ditch. Relocation of the ditch will be in accordance with levee design sections 10, 11, and 12, as shown on plate 8, and levee design sections 13 and 14, as shown on plate 9. Details of the ditch relocations are shown on plate 22.

85. The NASA access road along the Michoud Canal between stations 581+45 and 598+45 will be relocated to the west to provide sufficient area for construction the levee enlargement. Drainage ditches and culverts equal in capacity to the drainage facilities for the existing road will be provided for the relocated road.

86. High pressure nitrogen lines, owned by Air Products and Chemicals, Inc., of New Orleans, La., which run parallel to the levee alignment from approximate station 610+20 to station 627+00 and then cross the levee at the latter station, will be relocated over the protection levee. The proposed alignment of the relocated nitrogen lines is shown on plate 22. Air Products and Chemicals, Inc., is under contract to supply continuous nitrogen service to NASA.

Accordingly, relocation of the nitrogen lines will be coordinated with levee construction to minimize interruption of service.

87. The culvert at approximate station 626+00 will be shifted landward to provide sufficient area for construction of the levee enlargement.

88. Floodwalls. The following pipelines, locations of which are shown on plates 13 through 18, and 20, will be modified to pass through the floodwall as shown on plate 27; except that the 8-inch water line with fire hydrant will be relocated in the wave berm on the MR-GO side of the floodwall, rather than passing through the floodwall.

Pipelines	Stations
1 - 24" gas main	433+50
2 - 30" steel discharge pipes	255+61
2 - 66" C.I. cooling water intakes	440+35
2 - 42" C.I. cooling water intakes	441+07
14" oil line	448+83
6" electric conduit	448+83
3" electric conduit	448+83
2-1/2" electric conduit	448+83
1" electric conduit	448+83
Electrical conduit	449+38
8" water line	447+24
15" water line	436+40
90"Ø concrete pipe - cooling water outlet	452+70
4-54" steel discharge	574+32
8" water line with fire hydrant	450+36

COST ESTIMATES

89. Citrus Back Levee. Based on July 1967 price levels, the estimated total first cost for the Citrus Back Levee is $11,900,000 comprised of $8,389,000 for construction, $3,215,000 for lands and damages, and $296,000 for relocations. Detail estimates of first cost are shown in table 4 .

90. Lake Pontchartrain Barrier Plan. Cost estimates to full design memorandum scope are available only for the Citrus Back Levee and the protective works on the west bank of the IHNC between Florida Avenue and the IHNC lock. The cost estimates for the remainder of the Barrier Plan, are, in general, updated survey report costs. Based

on July 1967 price levels, the estimated total first cost for the Lake Pontchartrain Barrier Plan is $121,000,000, comprised of $104,700,800 for construction, $16,299,200 for lands, damages and relocations. The total Federal first cost is estimated to be $81,983,500 and the total non-Federal first cost is estimated to be $39,016,500, inclusive of the lands and damages and relocations above, and $22,717,300 in cash or equivalent work. An estimate of the apportionment of cost between Federal and non-Federal interests is shown in table 5 Survey scope estimates of first cost are shown in table 6.

TABLE 4

DETAILED ESTIMATE OF FIRST COST (CITRUS BACK LEVEE)

Item No.	Description	Estimated quantity	Unit	Unit price	Estimated amount
	CONSTRUCTION				
11	Levees & floodwalls				
	Sta. 175+76 to 431+00 and sta. 507+45 to 571+60				
	1st lift - cast	983,000	c.y.	1.60	$ 1,572,800
	2d lift - cast	257,000	c.y.	1.60	411,200
	3d lift - barge	130,000	c.y.	3.00	390,000
	4th lift - barge	104,000	c.y.	3.00	312,000
	Sta. 454+75 to 507+45 and sta. 584+14 to 664+73				
	1st lift - barge	511,000	c.y.	3.00	1,533,000
	1st lift - cast	55,000	c.y.	0.40	22,000
	2d lift - barge	50,000	c.y.	3.00	150,000
	2d lift - cast	80,000	c.y.	0.25	20,000
	3d lift - barge	64,000	c.y.	3.00	192,000
	4th lift - barge	36,000	c.y.	3.00	108,000
	Foreshore protection				
	Sta. 175+76 to 507+45 (along MR-GO)				
	Excavation	42,000	c.y.	0.40	16,800
	Shell	18,500	c.y.	3.50	64,750
	Riprap	60,000	ton	6.50	390,000
	Sta. 507+45 to 664+73.3				
	Excavation	37,000	c.y.	0.40	14,800
	Shell	10,500	c.y.	3.50	36,750
	Riprap	30,000	ton	6.50	195,000
	Slope protection				
	Sta. 628+00 to 636+00				
	Riprap	4,080	ton	6.50	26,520
	Shell	1,200	c.y.	3.50	4,200
	Fertilizing & seeding	192	acres	150.00	28,800
	Clearing & grubbing	170	acres	150.00	25,500
	Subtotal				$ 5,514,120

TABLE 4 (cont'd)

Item No.	Description	Estimated quantity	Unit	Unit price	Estimated amount
	FLOODWALLS				
	Excavation	1,820	c.y.	1.50	$ 2,730
	Steel sheet piling, Z-27	123,580	s.f.	3.40	420,172
	Steel sheet piling, MA-22	4,060	s.f.	3.30	13,398
	Concrete piling - 12" sq.	3,290	l.f.	7.50	24,675
	Concrete - for I-walls	6,260	c.y.	50.00	313,000
	Concrete - for gate monolith	140	c.y.	60.00	8,400
	Portland cement	8,810	bbl.	5.00	44,050
	Reinf. steel	650,000	lb.	0.15	97,500
	Available levee fill	3,750	c.y.	1.50	5,625
	Non-available levee fill	16,820	c.y.	3.00	50,460
	Levee cut	1,770	c.y.	1.00	1,770
	Backfill	160	c.y.	3.00	480
	Stabilization slab	24	c.y.	50.00	1,200
	Neoprene rubber gate seals	110	l.f.	5.00	550
	Struct. steel	18,300	lb.	0.40	7,320
	Trolley, plain (2-ton)	3	ea.	150.00	450
	Trolley, geared (2-ton)	3	ea.	150.00	450
	Subtotal				$ 992,230
	Subtotal, Levees & floodwalls				$ 6,506,350
	Contingencies, 20%				1,328,650
11	Levees and floodwalls, total const. cost				$ 7,835,000
30	Engineering & design, 8.5%				666,000
31	Supervision & administration, 6.9%				541,000
	Subtotal				$ 9,042,000
11	Foreshore protection (MR-GO)(1)				471,550
	Contingencies, 20%				94,450
30	Engineering & design, 8.5%				48,000
31	Supervision & administration, 6.9%				39,000
	Total cost levees & floodwalls				$ 8,389,000

(1) Chargeable to MR-GO project

TABLE 4 (cont'd)

Item No.	Description	Estimated quantity	Unit	Unit price	Estimated amount
	LANDS				
	West of Paris Road	220	acres	varies	$ 1,315,000
	East of Paris Road	120	acres	varies	1,477,500
	Severance - None				
	Improvements - fencing	lump sum		lump sum	3,500
	Total lands & improvements				$ 2,796,000
	Contingencies, 15%				417,400
	Real estate hired labor cost (8 tracts)				200
	Acquisition cost by others (8 tracts)				1,400
	Total real estate cost				$ 3,215,000
	RELOCATIONS				
1.	30" discharge pipes	2	ea.	1,500	$ 3,000
2.	15" discharge pipe	1	ea.	1,000	1,000
3.	24" gas pipeline	1	ea.	4,000	4,000
4.	66" C.I. cooling water intake	2	ea.	1,000	2,000
5.	42" C.I. cooling water intake	2	ea.	1,000	2,000
6.	14" oil line	1	ea.	1,000	1,000
7.	6" electric conduit	1	ea.	700	700
8.	3" electric conduit	1	ea.	600	600
9.	2-1/2" electric conduit	1	ea.	400	400
10.	1" electric conduit	1	ea.	300	300
11.	8" water line	1	ea.	800	800
12.	90" Ø concrete pipe-cooling water outlet	1	ea.	5,000	5,000
13.	54" discharge pipes	4	ea.	2,000	8,000
14.	Electric cable	1	ea.	500	500
15.	8" water line w/fire hydrant	50	l.f.	15	750
	Subtotal				$ 30,050
	Contingencies, 20%				6,050
	Subtotal				$ 36,100
	Engineering & design, 8.5%				3,300
	Supervision & administration, 6.9%				2,600
	Subtotal relocations - pipelines through floodwalls				$ 42,000

TABLE 4 (cont'd)

Item No.	Description	Estimated quantity	Unit	Unit price	Estimated amount
	RELOCATIONS - LEVEE				
1.	Modification to pumping station and ramp at bulk loading facility	1		lump sum	$ 17,000
2.	16" gas pipeline	500	l.f.	35.00	17,500
3.	Road relocation to NASA Michoud loading dock				
	6" transit water pipe	400	l.f.	6.00	2,400
	Power & telephone fac.	1		lump sum	2,600
	Embankment, haul	2,000	c.y.	3.50	7,000
	Compacted, subgrade	400	c.y.	5.00	2,000
	Asphalt-concrete surf.	2,500	s.y.	3.00	7,500
	Culvert, 3 - 54" x 110' CMP	1		lump sum	9,900
4.	Pumping station access road along Michoud Canal				
	Embankment, haul	2,500	c.y.	3.50	8,750
	Asphalt surfacing	3,000	s.y.	3.60	10,800
	Culvert,18"x40' CMP	1	ea.	240.00	240
	Culvert,24"x40' CMP	3	ea.	400.00	1,200
	Culvert,48"x40' CMP	1	ea.	1,000.00	1,000
5.	Culverts, 3 ea.	1		lump sum	1,200
6.	Nitrogen pipelines(NASA) 1-10", 1-2-1/2", 1-1"	2,350	l.f.	40.00	94,000
	Subtotal				$ 183,090
	Contingencies, 20%				36,910
	Subtotal				$ 220,000
	Engineering & design, 8.5%				19,000
	Supervision & administration, 6.9%				15,000
	Subtotal, relocations - levees				$ 254,000
	Total relocations				$ 296,000

TABLE 5

ESTIMATE OF APPORTIONMENT OF COST
BETWEEN FEDERAL AND NON-FEDERAL INTERESTS
(LAKE PONTCHARTRAIN BARRIER PLAN)

Project first cost	
Construction	$104,700,800
Lands, damages, & relocations	16,299,200
Total first cost	$121,000,000
Less one-half Seabrook Lock	-3,665,000
Amount to be apportioned	$117,335,000

Apportionment of cost	Federal 70%	Non-Federal 30%
Apportionment	$82,134,500	$35,200,500
One-half Seabrook Lock	+3,665,000	-
OM&R Rigolets Lock	-3,816,000	+3,816,000
Total cost	$81,983,500	$39,016,500
Lands, damages, & relocations	-	-16,299,200
Cash contribution	-	$22,717,300

TABLE 6

LAKE PONTCHARTRAIN BARRIER PLAN
ESTIMATE OF FIRST COST
Project document cost escalated to July 1967 price levels
(except as noted)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
RIGOLETS COMPLEX					
Construction					
05	Navigation lock				
	Excavation	76,000	c.y.	$ 1.50	$ 114,000
	Backfill	21,000	c.y.	1.00	21,000
	Dewatering	1	job	job	200,000
	Concrete, gate bay walls	3,180	c.y.	40.00	127,200
	Concrete, gate bay slabs	8,350	c.y.	20.00	167,000
	Concrete, chamber walls	1,200	c.y.	60.00	72,000
	Cement	15,800	bbl.	5.00	79,000
	Reinforcing steel	1,898,000	lb.	0.15	284,700
	Pipe handrail	2,400	l.f.	7.50	18,000
	Steel sheet piling, MA-22	5,200	s.f.	3.50	18,200
	Steel sheet piling, Z-32	4,650	s.f.	5.25	24,412
	Concrete sheet piles	35,000	l.f.	7.00	245,000
	Concrete batter piles(12")	7,000	l.f.	7.00	49,000
	Steel sheet pile bumper (quadrant) high	-	lump sum		30,000
	Steel sheet pile bumper (quadrant) low	-	lump sum		22,000
	Timber guide walls	900	l.f.	150.00	135,000
	Floodwalls	170	l.f.	150.00	25,500
	Bulkheads, high gate	-	lump sum		32,000
	Bulkheads, low gate	-	lump sum		25,000
	Sector gates	-	lump sum		303,000
	Misc. structural steel	17,000	lb.	0.30	5,100
	Riprap	12,380	ton	8.00	99,040
	Filter (gravel)	840	c.y.	8.00	6,720
	Filter (shell)	3,500	c.y.	3.50	12,250
	Control houses	4	ea.	8,000.00	32,000
	Subtotal				$ 2,147,122
	Price level increase				551,810
	Subtotal				$ 2,698,932
	Sector gate machinery	1	lump sum		170,000*
	Electrical system	1	lump sum		200,000*
	Cathodic protection		lump sum		110,000*
	Subtotal				$ 3,178,932
	Contingencies, 20%+				636,068
	Subtotal lock				$ 3,815,000

*1 July 1967 price levels

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT (cont'd)					
RIGOLETS COMPLEX (cont'd)					
08	Roads				
	Highway 90 relocation				
	1st lift, pump	220,000	c.y.	$0.76	$ 167,200
	2d lift, shape	15,000	c.y.	0.40	6,000
	3d lift, shape	7,000	c.y.	0.40	2,800
	Concrete surfacing	15,500	~~s.f.~~ s.y.	5.50	85,250
	Fertilizing and seeding	15	ac.	75.00	1,125
	Subtotal				$ 262,375
	Price level increase				70,130
	Subtotal				$ 332,505
	Contingencies 20%				66,495
	Subtotal roads				$ 399,000
09	Channels and canals				
	Floodway channel	21,293,000	c.y.	0.18	3,832,740
	Navigation channel	333,000	c.y.	0.18	59,940
	Subtotal				$3,892,680
	Price level increase				1,000,418
	Subtotal				$4,893,098
	Contingencies 20%				978,402
	Subtotal channels and canals				$5,872,000
11	Levees and floodwalls				
	Closure dam, Rigolets				
	1st lift, pump	2,377,000	c.y.	0.80	1,901,600
	2d lift, pump	1,188,000	c.y.	0.80	950,400
	3d lift, shape	356,000	c.y.	0.50	178,000
	4th lift, shape	214,000	c.y.	0.50	107,000
	5th lift,shape	143,000	c.y.	0.50	71,500
	Riprap	198,000	ton	8.00	1,584,000
	Shell	59,000	c.y.	4.50	265,500
	Levee north of Rigolets				
	1st lift, pump	466,000	c.y.	0.70	326,200
	2d lift, pump	233,000	c.y.	0.70	163,100
	3d lift, shape	97,000	c.y.	0.50	48,500
	4th lift,shape	42,000	c.y.	0.50	21,000
	Shell	2,400	c.y.	8.00	19,200
	Fertilizing & seeding	34	ac	100.00	3,400
	Levee south of Rigolets				
	Embankment, cast	245,000	c.y.	0.60	147,000
	Fertilizing & seeding	35	ac	100.00	3,000
	Subtotal				$5,789,400

TABLE 6 (cont'd)

Item	Description	Estimated quantity	unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
RIGOLETS COMPLEX (cont'd)					
11	Levees and floodwalls (cont'd)				
	Subtotal (brought forward)				$5,789,400
	Price level increase				272,101
	Subtotal				$6,061,501
	Contingencies 20%				1,162,499
	Subtotal levees and floodwalls				$7,224,000
15	Control structure				
	Excavation	172,000	c.y.	$1.50	$ 258,000
	Backfill	12,000	c.y.	0.80	9,600
	Dewatering	1	job	job	375,000
	Filter gravel	2,000	c.y.	8.00	16,000
	Filter sand	1,000	c.y.	8.00	8,000
	Riprap (in channel)	13,500	ton	10.00	135,000
	Gravel	4,500	c.y.	8.00	36,000
	Steel sheet piling (MA-22)	24,600	s.f.	3.50	86,100
	Concrete, Cl.A - Hwy. & Cr.Br.	3,521	c.y.	75.00	264,075
	Concrete, Cl.A - Piers & Curt.wls.	6,944	c.y.	30.00	208,320
	Concrete, Cl.A - Floor slab	10,834	c.y.	20.00	216,680
	Concrete, Cl.A - Bents & Abutm.	1,206	c.y.	40.00	48,240
	Concrete, stab. slab	1,084	c.y.	15.00	16,260
	Cement	31,500	bbls.	5.00	157,500
	Reinf. steel	3,400,000	lb.	0.175	595,000
	Timber piles, untreated	14,080	l.f.	1.50	21,120
	Steel piling, 12BP-53#	55,680	l.f.	7.00	389,760
	Struc. steel - gates & misc.	3,300,000	lb.	0.45	1,485,000
	Water stops	550	l.f.	5.00	2,750
	Pipe handrail 1-1/2"	4,350	l.f.	7.50	32,625
	Crane rails	58,000	lb.	0.35	20,300
	Subtotal				$4,381,330
	Price level increase				1,126,000
	Subtotal				5,507,330
	Gantry crane	1	lump sum		395,000*
	Lighting	1	lump sum		30,000*
	Subtotal				$5,932,330
	Contingencies 20%				1,186,670
	Subtotal control structure				$7,119,000

*1 July 1967 price level

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
RIGOLETS COMPLEX (cont'd)					
	Rigolets Complex construction cost				$24,429,000
30	Engineering and design 7.9%				1,930,000
31	Supervision and administration 6.8%				1,661,800
	Total construction				$28,020,800
Lands					
	Levee	160	ac.		256,000
	Relocated highway	18	ac.	100.00	1,800
	Control str. & channel	192	ac.	2,600.00	499,200
	Navigation str. & channel	40	ac.	66.00	2,640
	Spoil disposal	300	ac.	90.00	27,000
	Subtotal				$ 786,640
	Contingencies 15%				117,360
	Total lands				$ 904,000
Relocations					
	Aerial powerline	1	lump sum		30,000
	AT&T coaxial cable	1	lump sum		83,200
	Telephone cable	1	lump sum		10,000
	Subtotal				$ 123,200
	Contingencies 20%				24,800
	Subtotal				$ 148,000
	E&D				12,000
	S&A				10,000
	Total relocations				$ 170,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
CHEF MENTEUR COMPLEX					
Construction					
05	Navigation structure				
	Gate bay and approaches				
	Excavation	30,000	c.y.	$1.50	$ 45,000
	Backfill	14,100	c.y.	0.80	11,280
	Sand backfill	4,000	c.y.	5.00	20,000
	Dewatering	1	job	job	155,000
	Concrete, Cl. A - walls	1,654	c.y.	40.00	66,160
	Concrete, Cl. A - flr. salbs	3,204	c.y.	20.00	64,080
	Cement	6,800	bbl.	5.00	34,000
	Reinf. steel	680,000	lb.	0.175	119,000
	Pipe handrail	1,100	l.f.	7.50	8,250
	Steel sheet piling, MA-22	6,640	s.f.	3.50	23,240
	Steel piling 12 BP 53	7,590	l.f.	7.00	53,130
	Untreated timber piling - B	8,580	l.f.	1.50	12,870
	Filter gravel	285	c.y.	8.00	2,280
	Filter sand	143	c.y.	8.00	1,144
	Riprap	1,120	ton	10.00	11,200
	Gravel	170	c.y.	8.00	1,360
	Sand	170	c.y.	8.00	1,360
	Floodwalls (2)				
	Concrete, Class A	165	c.y.	40.00	6,600
	Cement	230	bbl.	5.00	1,150
	Reinf. steel	16,500	lb.	0.175	2,888
	Steel sheet piling, MZ-32	4,940	s.f.	5.25	25,935
	Bulkheads (4)				
	Steel Sheet piling, MA-22	4,610	s.f.	3.50	16,135
	Struc. steel - wales, tie rods	35,000	lb.	0.30	10,500
	Timber guide walls				
	Treated timber piles	6,000	l.f.	2.00	12,000
	Treated timber	27	MFBM	500.00	13,500
	Sector gate				
	Struc. steel	220,000	lb.	0.45	99,000
	Pipe handrail 1-1/2"	340	l.f.	7.50	2,550
	Rubber seals	180	l.f.	4.50	810
	Timber fenders	3	MFBM	500.00	1,500
	Painting	1	job	job	3,000
	Cathodic protection	1	job	job	15,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
	NEW ORLEANS EAST UNIT				
	CHEF MENTEUR COMPLEX (cont'd)				
	Construction (cont'd)				
	Upper and lower hinges				
	Structural steel	5,000	lb.	$0.45	$ 2,250
	Cast steel	3,600	lb.	0.50	1,800
	Bronze	600	lb.	2.00	1,200
	Roller track, seal plates, beams				
	Structural steel	9,000	lb.	0.45	4,050
	Corrosion resistant steel	4,500	lb.	1.25	5,625
	Needle beam seats, corner protect. plates, ladders				
	Struct. steel	10,000	lb.	0.30	3,000
	Subtotal				$ 857,847
	Price level increase				220,466
	Subtotal				$1,078,313
	Sector gate machinery	1	lump sum		67,500*
	Cathodic protection	1	lump sum		10,000*
	Electrical system	1	lump sum		90,000*
	Subtotal				$1,245,813
	Contingencies 20%				249,187
	Subtotal navigation structure				$1,495,000
*1 July 1967 price level					
09	Channels and canals				
	Navigation channel	980,000	c.y.	0.20	196,000
	Floodway channel	7,200,000	c.y.	0.20	1,440,000
	Subtotal				$1,636,000
	Price level increase				76,892
	Subtotal				$1,712,892
	Contingencies 20%				342,508
	Subtotal channels and canals				$2,055,400
11	Levees and floodwalls				
	Chef Menteur closure				
	1st lift, pump	1,560,000	c.y.	0.80	1,248,000
	2d lift, pump	780,000	c.y.	0.80	624,000
	3d lift, shape	234,000	c.y.	0.50	117,000
	4th lift, shape	140,000	c.y.	0.50	70,000
	5th lift, shape	94,000	c.y.	0.50	47,000
	Riprap	71,400	ton	8.00	571,200
	Shell	20,400	c.y.	4.50	91,800

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
	CHEF MENTEUR COMPLEX (cont'd)				
11	Levees and floodwalls (cont'd)				
	GIW closures (2)				
	1st lift, pump	153,000	c.y.	$0.70	$ 107,100
	2d lift, pump	77,000	c.y.	0.70	53,900
	3d lift, shape	24,000	c.y.	0.50	12,000
	4th lift, shape	22,000	c.y.	0.50	11,000
	Riprap	15,800	ton	8.00	126,400
	Shell	4,600	c.y.	4.50	20,700
	Levees				
	*1st lift, pump	1,356,000	c.y.	0.70	949,000
	2d lift, pump	679,000	c.y.	0.70	475,300
	3d lift, shape	284,000	c.y.	0.50	142,000
	4th lift, shape	122,000	c.y.	0.50	61,000
	Riprap	39,200	ton	13.00	509,600
	Shell	16,200	c.y.	8.00	129,600
	Fertilizing and seeding	100	ac.	150.00	10,000
	Subtotal				$5,375,100
	Price level increase				252,700
	Subtotal				$5,629,300
	Contingencies 20%				1,125,900
	Subtotal levees and floodwalls				$6,755,200

*Includes cost for excavating GIW and part of nav. and floodway channels

15	Control Structure				
	Excavation	105,300	c.y.	$1.50	$ 157,950
	Backfill	15,000	c.y.	0.80	12,000
	Dewatering	1	job	job	340,000
	Filter gravel	550	c.y.	8.00	4,400
	Filter sand	275	c.y.	8.00	2,200
	Riprap - in channel	6,548	ton	10.00	65,480
	Gravel	2,150	c.y.	8.00	17,200
	Steel sheet piling, MA-22	12,480	s.f.	3.50	43,680
	Concrete, Cl.A - Crane Girders	588	c.y.	75.00	44,100
	Concrete, Cl.A - Piers & cur.walls	3,175	c.y.	30.00	95,250
	Concrete, Cl.A - Floor slab	5,134	c.y.	20.00	102,680
	Concrete, Cl.A - Bents & abutm.	880	c.y.	40.00	35,200
	Cement	13,700	bbls.	5.00	68,500
	Reinf. steel	1,400,000	lb.	0.175	245,000
	Steel piling 12B53#	8,190	l.f.	7.00	57,330
	Struc. steel - gates & misc.	1,300,000	lb.	0.45	585,000
	Waterstops	200	l.f.	5.00	1,000
	Pipe handrails 1-1/2"	1,400	l.f.	7.50	10,500

TABLE 6 (contd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
	NEW ORLEANS EAST UNIT				
	CHEF MENTEUR COMPLEX (cont'd)				
15	Floodway control and diversion structures (cont'd)				
	Crane rails	28,000	lb.	$0.35	$ 9,800
	Subtotal				$1,897,270
	Price level increase				487,598
	Subtotal				$2,384,868
	Gantry crane	1	lump sum		395,000
	Lighting	1	lump sum		15,000
	Subtotal				$2,794,868
	Contingencies 20%				559,132
	Subtotal floodway control and diversion struc.				$3,354,000
	Chef Menteur Complex construction cost				$13,659,600
30	Engineering and design 7.9%				1,079,000
31	Supervision and administration 6.8%				928,400
	Total construction				$15,667,000
	Lands				
	Levee	269	ac.	1,087.00	$ 292,403
	Control str. and channel	184	ac.	404.00	74,336
	Relocate GIW	354	ac.	200.00	70,800
	Lock and navigation channel	57	ac.	203.00	11,571
	Spoil disposal	279	ac.	151.00	42,129
	Subtotal				$ 491,239
	Contingencies 15%				73,761
	Total lands				$ 565,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
NEW ORLEANS EAST					
Construction					
11	Levees and floodwalls				
	Lakefront levee				
	1st lift, pump	4,525,000	c.y.	$0.77	$3,484,250
	2d lift, pump	1,508,000	c.y.	0.77	1,161,160
	3d lift, shape	302,000	c.y.	0.40	120,800
	4th lift, shape	181,000	c.y.	0.40	72,400
	5th lift, shape	121,000	c.y.	0.40	48,400
	Riprap	240,000	ton	6.50	1,560,000
	Shell	52,000	c.y.	3.50	182,000
	Fertilizing and seeding	194	ac.	150.00	29,100
	Back levee (Michoud Canal)				
	1st lift, barge	570,000	c.y.	4.00	2,280,000
	2d lift, barge	380,000	c.y.	4.00	1,520,000
	Fertilizing and seeding	40	ac	150.00	6,000
	Back levee (GIW)				
	1st lift, pump	2,130,000	c.y.	0.77	1,640,100
	2d lift, pump	1,420,000	c.y.	0.77	1,093,400
	3d lift, shape	710,000	c.y.	0.40	284,000
	4th lift, shape	426,000	c.y.	0.40	170,400
	Riprap	62,000	ton	6.50	403,000
	Shell	18,000	c.y.	3.50	63,000
	Fertilizing and seeding	130	ac	150.00	19,500
	Subtotal				$14,137,510
	Contingencies 20%				2,807,490
	Total levees and floodwalls				$16,945,000
30	Engineering and design 7.9%				1,340,300
31	Supervision and administration 6.8%				1,153,700
	Total construction				$19,439,000
Lands					
Lakefront					
	Improvements (camps)		lump sum		114,500
	Severance (none)				

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
NEW ORLEANS EAST (cont'd)					
Lands (cont'd)					
Back levee (Michoud Canal)					
	Lands	70	ac	varies	$ 907,500
	Severance	None			
	Improvements (fencing)		lump sum		1,000
Back levee (GIW)					
	Lands	465	ac	varies	3,068,750
	Severance	None			
	Improvements (fencing)		lump sum		1,200
	Total land & improvements				$4,092,950
	Contingencies 15%				613,950
	Real estate H/L cost (41 tracts)				1,025
	Acquisition cost by others (41 tracts)				7,175
	Total real estate cost				$4,715,100
Relocations					
Lakefront levee					
	1 - 20" pipeline	500	l.f.	105.00	52,500
	1 - 24" pipeline	500	l.f.	130.00	65,000
	Extend 2 - 42" Ø culvert	500	l.f.	20.00	10,000
Back levee					
	1 - 20" pipeline	500	l.f.	105.00	52,500
	1 - 24" pipeline	500	l.f.	130.00	65,000
	Subtotal				$ 245,000
	Contingencies 20%				49,000
	Subtotal				$ 294,000
	E&D				23,100
	S&A				19,900
	Total relocations				$ 337,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
Citrus Lakefront Levee Construction					
11	Levee and floodwalls				
	1st lift, pump	2,663,000	c.y.	$0.77	$2,050,510
	2d lift, pump	888,000	c.y.	0.77	683,760
	3d lift, shape	178,000	c.y.	0.40	71,200
	4th lift, shape	107,000	c.y.	0.40	42,800
	5th lift, shape	71,000	c.y.	0.40	28,400
	Riprap	159,000	ton	6.50	1,033,500
	Shell	39,000	c.y.	3.50	136,500
	Fertilizing and seeding	116	ac.	150.00	17,400
	Subtotal				$4,064,070
	Contingencies 20%				811,930
	Subtotal levees and floodwalls				$4,876,000
30	Engineering and design 8.5%				414,000
31	Supervision and administration 6.9%				336,000
	Total construction				$5,626,000
Lands					
Improvements					
	Camps		lump sum		555,000
	Lincoln Beach		lump sum		2,000,000
Severance			None		
	Total improvements				$2,555,000
	Contingencies 15%				383,000
	Real estate H/L cost (129 tracts)				3,225
	Acquisition cost by others (129 tracts)				22,575
	Total real estate cost				$2,964,050
	Rounded to				$2,964,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
Citrus back levee (GDM scope)					
Construction					
(For detailed estimates, see table 3)					
11	Levees and floodwalls				$7,269,000
30	Engineering and design				618,000
31	Supervision and administration				502,000
	Total Citrus back levee				$8,389,000
Lands					$3,215,000
Relocations					$ 296,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
	NEW ORLEANS LAKEFRONT				
	JEFFERSON PARISH LINE TO IHNC				
	Construction				
11	Levee and floodwalls				
	Levee embankment, barge	215,000	c.y.	$3.00	$ 645,000
	Fertilizing & seeding	42	ac.	150.00	6,300
	Subtotal				$ 651,300
	Contingencies 20%				130,700
	Total levee and floodwalls				$ 782,000
30	Engineering and design 7.9%				61,800
31	Supervision and administration 6.8%				53,200
	Total				$ 897,000
	Relocations				
	Road crossings	12	ea.	7,500.00	$ 90,000
	Contingencies 20%				18,000
	Subtotal				$ 108,000
	E&D				9,000
	S&A				7,000
	Total relocations				$ 124,000

TABLE 6(cont'd)

Item Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT				
INNER HARBOR NAVIGATION CANAL EAST SIDE				
Construction				
11 Levees and floodwalls				
Excavation	10,400	cu.yd.	$1.50	$ 15,600
Fill	11,000	cu.yd.	1.50	16,500
Piling, steel sheet, MA22	10,735	sq.ft.	3.00	32,205
Piling, steel sheet Z27	119,320	sq.ft.	3.25	387,790
Concrete	5,421	cu.yd.	75.00	406,575
Gates	8	ea.	12,000.00	96,000
Piling, prest. conc.12" sq.	29,600	l.f.	5.50	162,800
Corrosion protection		job		103,000
Pile tests		job		30,000
Riprap	8,500	tons	10.00	85,000
Ramp	1	ea.	100,000.00	100,000
Relief wells	4,200	l.f.	50.00	210,000
8" pipe for relief wells	1,600	l.f.	5.00	8,000
Fertilizing & seeding	30	ac.	110.00	3,300
Subtotal				$1,656,770
Contingencies 20%				330,230
Subtotal				$1,987,000
30 Engineering and design 7.9%				157,000
31 Supervision and administration 6.8%				135,000
Total				$2,279,000
Lands				
Lands	21.53	ac.	varies	$ 464,150
Severance	None			
Improvements (fencing)			lump sum	9,000
Total lands & improvements				$ 473,150
Contingencies 15%				70,975
Real estate hired labor cost (5 tracts)				125
Acquisition cost by others (5 tracts)				875
Total real estate cost				$ 545,125
Rounded to				$ 545,000

TABLE 6 (cont'd)

Item Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT				
INNER HARBOR NAVIGATION CANAL EAST SIDE (cont'd)				
Relocations				
50" water main	2	ea.	$4,000	$ 8,000
30" sewer main	1	ea.	4,000	4,000
16" gas	1	ea.	450	450
12" water	1	ea.	450	450
12" sewer	1	ea.	450	450
8" sewer	1	ea.	300	300
8" water	1	ea.	1,000	1,000
6" water	5	ea.	300	1,500
Telephone & TV cable	16	ea.	300	4,800
6" electric cable	4	ea.	80	320
16" water	1	ea.	450	450
6" gas	1	ea.	300	300
24" storm	1	ea.	4,000	4,000
36" storm	1	ea.	4,000	4,000
50" storm	1	ea.	5,000	5,000
18" storm	1	ea.	2,500	2,500
Electric cable	4	ea.	80	320
6" chlorine	1	ea.	350	350
1-1/2" air	2	ea.	300	600
10" oil	1	ea.	450	450
13.8 KV cable	1	ea.	5,000	5,000
Subtotal				$ 44,200
Contingencies 20%				8,800
				$ 53,000
E&D				4,200
S&A				3,600
Total relocations				$ 60,800

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT					
INNER HARBOR NAVIGATION CANAL WEST SIDE					
Construction					
11	Levees & floodwalls				
	Excavation	73,086	cu.yd.	$1.50	$ 109,629
	Fill	89,297	cu.yd.	1.50	133,945
	Piling, steel sheet, MA-22	143,628	sq.ft.	3.00	430,883
	Piling, steel sheet, Z-27	394,171	sq.ft.	3.25	1,281,055
	Concrete	20,121	cu.yd.	75.00	1,509,075
	Gates	27	ea.	12,000.00	324,000
	Piling, prestressed conc.12"sq.	169,095	l.f.	5.50	930,028
	Piling, steel pipe, 12-3/4" O.D.	10,200	l.f.	9.00	91,800
	Corrosion protection		job		203,750
	Pile tests		job		130,000
	Piling, steel sheet Z-27 Temp. coff.	35,280	sq.ft.	2.45	86,436
	Piling, steel sheet, Z-38	21,000	sq.ft.	4.20	88,200
	Steel, structural	87,060	lb.	0.50	43,500
	Riprap	18,570	tons	10.00	185,700
	Filter, gravel & sand	345	cu.yd.	10.00	3,450
	Ramps	3	ea.	100,000.00	300,000
	Relief wells	3,400	l.f.	50.00	170,000
	8" pipe for relief wells	1,400	l.f.	5.00	7,000
	Fertilizing & seeding	32.3	ac.	110.000	3,553
	Shell(under riprap in fdn)	1,720	cu.yd.	3.50	6,020
	Dewatering		job		10,000
	Subtotal				$6,048,024
	Contingencies 20%				1,209,976
	Subtotal				$7,258,000
30	Engineering and design 7.9%				573,000
31	Supervision and administration 6.8%				494,000
	Total construction				$8,325,000
Lands					
	Lands	39.15	ac.	varies	$ 646,246
	Severance	None			
	Improvements	None			
	Total lands & improvements				$ 646,246
	Contingencies 15%				96,925
	Real estate hired labor cost (8 tracts)				75
	Acquisition cost by others (8 tracts)				525
	Total real estate cost				$ 743,771
	Rounded to				$ 743,800

TABLE 6 (con'd)

Item Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS EAST UNIT				
INNER HARBOR NAVIGATION CANAL WEST SIDE				
Relocations				
54" sewer force main	1	ea.	$5,000	$ 5,000
50" water main	2	ea.	4,000	8,000
48" water main	1	ea.	5,000	5,000
42" sewer main	270	l.f.	70	18,900
30" sewer main	1	ea.	4,000	4,000
16" sewer	1	ea.	450	450
16" gas	2	ea.	450	900
16" gas	1	ea.	2,000	2,000
12" water	5	ea.	450	2,250
12" water	3	ea.	1,200	3,600
12" water line	180	l.f.	12	2,160
12" sewer	2	ea.	450	900
8" gas	1	ea.	300	300
8" sewer	1	ea.	300	300
8" water	3	ea.	1,000	2,000
6" water	4	ea.	300	1,200
6" water	2	ea.	900	1,800
4" sewer	1	ea.	300	300
3" water, air, diesel	5	ea.	500	1,500
2" water	1	ea.	200	200
1-1/2" water	1	ea.	300	300
Telephone & TV cable	9	ea.	300	2,700
6" telephone cable	1	ea.	500	500
6" electric cable	2	ea.	80	160
Modification to Fla. Ave. approach	1	lump sum		172,000
Modification to Fla. Wharf	1	lump sum		2,400
Modification to Chase Bag Co. ramp	1	lump sum		15,500
Modification to Lone Star Cement	1	lump sum		46,100
Modification to J&L Steel Co.	1	lump sum		24,300
Modification to Galvez St.wharf	1	lump sum		900
Modification to N.O. Public Belt RR	1	lump sum		81,000
Interior drainage	1	lump sum		70,000
Subtotal				$ 476,600
Contingencies 20%				95,300
Subtotal				$ 571,900
E&D				45,200
S&A				38,900
Total relocations				$ 656,000

TABLE 6 (cont'd)

Item Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS WEST UNIT				
ST. CHARLES PARISH				
CONSTRUCTION				
11 Levees & floodwalls				
Drainage structure (Dec 61 price level)				
Stripping	27,900	c.y.	$0.50	$ 13,950
Backfill (river sand)	38,700	c.y.	1.50	58,050
Steel sheet piling, Z-27	10,850	s.f.	4.50	48,825
Concrete cap	360	l.f.	8.00	2,880
Drain 4" perf. clay	145	l.f.	1.00	145
Drain 6" clay	160	l.f.	1.50	240
Drain flap gates	7	ea.	50.00	350
Gravel, drain	90	c.y.	8.00	720
Sand, drain	30	c.y.	8.00	240
Concrete	310	c.y.	80.00	24,800
Cement	390	bbl.	5.00	1,950
Reinf. steel	55,100	lb.	0.175	9,642
Cast iron gates(108"x60"-20' head)	8	ea.	3,400.00	27,200
Timber piles, treated	3,780	l.f.	2.00	7,560
Riprap	310	ton	10.00	3,100
Shell, filter	100	c.y.	3.50	350
Handrail (1-1/2" pipe)	840	l.f.	7.50	6,300
Subtotal				$206,302
price level increase				53,019
Subtotal				$259,321
Lakefront levee				
First lift, pump	1,700,000	c.y.	0.80	1,360,000
Second lift, pump	642,000	c.y.	0.80	513,600
Third lift, shape	108,000	c.y.	0.40	43,200
Fourth lift, shape	65,000	c.y.	0.40	26,000
Fifth lift, shape	43,000	c.y.	0.40	17,200
Riprap	165,000	ton	9.00	1,485,000
Shell	37,000	c.y.	3.50	129,500
Fertilizing & seeding	135	ac.	150.00	20,250
Excavation, drainage ditch	646,000	c.y.	0.30	193,800

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
CONSTRUCTION (cont'd)					
Lateral levee					
	First lift, pump	1,200,000	c.y.	$ 0.80	$ 960,000
	Second lift, pump	440,000	c.y.	0.80	352,000
	Third lift, shape	72,000	c.y.	0.40	28,800
	Fourth lift, shape	43,000	c.y.	0.40	17,200
	Fifth lift, shape	29,000	c.y.	0.40	11,600
	Fertilizing & seeding	94	ac.	150.00	14,100
	Excavation, drainage ditch	30,000	c.y.	0.30	9,000
	Subtotal				$5,440,571
	Contingencies 20%				1,186,429
	Subtotal				$6,627,000
30	Engineering and design 10.3%				686,000
31	Supervision and administration 7.7%				510,000
	Subtotal, St. Charles Parish Construction				$7,823,000
LANDS					
Lakefront levee		400	ac.	varies	$ 244,800
	Severance	1	lump sum		12,000
	Improvements	1	lump sum		20,000
Lateral levee		490	ac.	varies	408,750
	Severance	1	lump sum		5,000
	Improvements	None			
	Total lands & improvements				$ 690,550
	Contingencies, 15%				103,500
	Real estate hired labor cost (77 tracts)				1,925
	Acquisition cost by others (77 tracts)				13,475
	Total real estate cost				$ 809,450
	Rounded to				$ 809,500
RELOCATIONS					
	16" pipeline	400	l.f.	$85.00	$ 34,000
	18" pipeline	400	l.f.	95.00	38,000
	30" pipeline	400	l.f.	160.00	64,000
	Subtotal				$ 136,000
	Contingencies 20%				27,000
	Subtotal				$ 163,000
	E&D				18,000
	S&A				13,000
	Total relocations				$ 194,000

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
NEW ORLEANS WEST UNIT					
JEFFERSON PARISH					
CONSTRUCTION					
11	Levees & floodwalls				
	Riprap	46,100	ton	$8.00	$ 368,800
	Shell	11,300	c.y.	3.50	39,550
	Subtotal				$ 408,350
	Contingencies 20%				81,650
	Subtotal				$ 490,000
30	Engineering and design 10.3%				50,000
31	Supervision and administration 7.7%				37,000
	Subtotal, Jefferson Parish construction				$ 577,000
LANDS					
	None				
RELOCATIONS					
	None				

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
SEABROOK LOCK UNIT					
SEABROOK LOCK STRUCTURE					
05	Locks				
	Dewatering (during const.)	1	job	job	$ 345,000
	Permanent relief wells	1	job	job	89,000
	Excavation (under water)	23,000	c.y.	$4.00	92,000
	Concrete (tremie placed-slab)	7,400	c.y.	35.00	259,000
	Concrete, gate bay slabs	10,500	c.y.	35.00	367,500
	Concrete, gate bay walls	4,150	c.y.	50.00	207,500
	Concrete, approach bridges	60	c.y.	80.00	4,800
	Cement	31,300	bbl.	6.00	187,800
	Reinf. steel	2,205,000	lb.	0.17	374,850
	Steel sheet piling, MZ-32	17,100	s.f.	4.50	76,950
	Steel sheet piling, MZ-38 (drive & pull twice w/full salvage value)	41,500	s.f.	4.00	166,000
	Struct. steel, misc. shapes	380,000	lb.	0.25	95,000
	Pipe handrail	5,100	l.f.	6.00	30,600
	Concrete cylinder piles 18"	360	l.f.	10.00	3,600
	Concrete cylinder piles 54"	12,320	l.f.	40.00	492,800
	Concrete cap, cylinder piles	1,220	l.f.	20.00	24,400
	Timber wales (12"x12" Greenheart)	45	MFBM	600.00	27,000
	Riprap	10,400	ton	8.00	83,200
	Shell (filter)	1,000	c.y.	3.50	3,500
	Timber guide walls	850	l.f.	125.00	106,250
	Sheet pile bumper (quadrants)	2	ea.	20,000.00	40,000
	Sheet pile dolphin - 34' diam.	1	ea.	30,000.00	30,000
	Sector gates	1	job	job	353,000
	Subtotal				$3,491,750
	Price level increase				897,379
	Subtotal				$4,389,129
	Cathodic protection	1	lump sum		110,000*
	Sector gate machinery	1	lump sum		170,000*
	Electrical system	1	lump sum		200,000*
	Subtotal				$4,869,129
	Contingencies 20%				973,871
	Subtotal				$5,843,000
30	Engineering and design 7.7%				450,000
31	Supervision and administration 7.2%				421,000
	Subtotal lock structure				$6,714,000

*1 July 1967 price level

TABLE 6 (cont'd)

Item	Description	Estimated quantity	Unit	Unit price	Estimated amount
SEABROOK LOCK UNIT					
SEABROOK LOCK STRUCTURE (cont'd)					
Rock dam (Dec 61 price level)					
	Shell	26,200	c.y.	$2.50	$ 65,500
	Riprap	6,500	tons	8.00	52,000
	Derrick stone	10,500	tons	9.00	94,500
	Steel sheet pile, MA-22	35,770	s.f.	4.00	143,080
	Subtotal				$ 355,080
	Price level increase				91,255
	Subtotal				$ 446,335
	Contingencies 20%				89,665
	Subtotal				$ 536,000
30	Engineering and design 7.7%				41,000
31	Supervision and administration 7.2%				39,000
	Subtotal rock dam				$ 616,000
	Total Seabrook Lock Construction				$7,330,000
MANDEVILLE UNIT					
MANDEVILLE SEAWALL (Dec 61 price levels)					
(Strengthening of existing wall)					
11	Levees and floodwalls				
	Riprap	11,620	ton	$10.00	$ 116,200
	Clamshell backfill	5,580	c.y.	5.00	27,900
	Clay blanket	1,520	c.y.	2.00	3,040
	Random backfill	2,300	c.y.	1.50	3,450
	Excavation	3,364	c.y.	1.50	5,046
	Concrete sheet pile	200	l.f.	75.00	15,000
	Subtotal				$ 170,636
	Price level increase				43,853
	Subtotal				$ 214,489
	Contingencies 20%+				43,511
	Subtotal			258.00	$ 252,000
30	Engineering and design 15%+				39,000
31	Supervision and administration 12%+				31,000
	Total construction				$ 328,000

Par 91.

COMPARISON OF COST

91. Citrus Back Levee. The cost of $11,900,000 for the Citrus Back Levee represents an increase of $5,832,000 over the latest PB-3 dated 1 July 1967. Table 7 shows a comparison of the project document, PB-3 and design memorandum estimates. Reasons for difference between the design memorandum and PB-3 estimates are as follows:

Levees and floodwalls. The increase of $3,341,000 reflects the added cost for constructing the protective works to higher net grades which resulted from hydraulic studies utilizing more severe parameters for the Standard Project Hurricane furnished by the U. S. Weather Bureau subsequent to project authorization; an additional increase in the height of the protective works above natural ground of approximately one foot resulting from releveling by the U. S. Coast and Geodetic Survey which in 1965 disclosed that ground surfaces in the project area were about one foot lower than they were considered to be when the project document cost estimates were prepared; modifications in design cross sections for levees resulting from the increases in the height of protective works as described above; using floodwall in lieu of earth embankment in three locations where embankment construction was impracticable; and general refinements in the cost estimate based on the more detailed information available.

Engineering and design. The increase of $304,000 reflects the added E&D on the increased construction cost.

Supervision and administration. The increase of $239,000 reflects the added S&A on the increased construction cost.

Lands and damages. The increase of $1,746,000 reflects the additional land required as a result of the larger levee sections made necessary for the reasons stated above, and an increase in unit values for land based on the detailed appraisals made for this memorandum.

Relocations. The increase of $296,000 is the total increase in relocations cost for the Citrus Back Levee. The project document plan did not recognize the need for any relocations along this reach of levee.

92. General. The total cost of $121,000,000 presented in this memorandum for the Lake Pontchartrain Barrier Plan represents an increase of $20,672,000 over that shown on the latest PB-3 dated 1 July 1967. A comparison of the project document, PB-3 and design memorandum estimates of cost is shown on Table 8. Reasons for differences between the design memorandum and PB-3 estimates are as follows:

Par 92.

Locks. The total increase of $771,400 reflects an increase in cost of the sector gate machinery and electrical systems for the Rigolets Lock, Chef Menteur Navigation Floodgate and Seabrook Lock, based on additional cost studies made for this memorandum.

Channels and canals. The increase of $60,400 is a result of the adjustment necessary to round off the total project cost to three significant figures.

Levees and floodwalls. The total increase of $8,084,200 is comprised of $3,341,000, as described in paragraph 91, for the Citrus Back Levee, and $4,743,200 which represents the added cost for constructing the other levees of the New Orleans East Unit to a higher net grade resulting from the various factors described for the Citrus Back Levee, with the exception of the increase in height of protective works as a result of the U. S. Coast and Geodetic Survey releveling; and an increase in design cross sections for levees resulting from the increase in net grade as described above.

Control structures. The increase of $367,000 reflects an increase in cost of the gantry cranes for the Rigolets and Chef Menteur Control Structures, based on additional cost studies made for this memorandum.

Engineering and design. The total increase of $776,700 represents the added E&D on the increased construction cost.

Supervision and administration. The total increase of $668,100 represents the added S&A on the increased construction cost.

Lands and damages. The total increase of $8,943,400 is comprised of $1,746,000, as described in paragraph 91, for the Citrus Back Levee and $7,197,400 which reflects the additional land required for the other levees covered in this memorandum as a result of the larger levee sections made necessary by the increase in protective height as previously described.

Relocations. The total increase of $1,000,800 is comprised of $296,000 as previously described for the Citrus Back Levee and $704,800 which reflects the additional relocations required in the New Orleans East and West Units as a result of additional field investigations made subsequent to project authorization.

TABLE 7

CITRUS BACK LEVEE
COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff. 1 Jul 67	Design Memo No. 2	Difference DM No. 2 - PB-3
11	Levees & floodwalls	$ 3,093,000	$ 3,928,000	$ 7,269,000	$ +3,341,000
30	Engineering & design	124,000	314,000	618,000	+304,000
31	Supervision & administration	186,000	263,000	502,000	+239,000
	Subtotal	$ 3,403,000	$ 4,505,000	$ 8,389,000	$ +3,884,000
	Lands & damages	1,072,000	1,469,000	3,215,000	+1,746,000
	Relocations	-	-	296,000	+296,000
	Subtotal	$ 1,146,000	$ 1,563,000	$ 3,511,000	$ +1,948,000
	Total Citrus back levee	$ 4,549,000	$ 6,068,000	$11,900,000	$ +5,832,000

TABLE 8

LAKE PONTCHARTRAIN BARRIER PLAN
COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff. 1 Jul 67	Design Memo No. 2	Difference DM No. 2 - PB-3
05	Locks:				
	New Orleans East Unit	$ 3,557,000	$ 4,692,000	$ 5,310,000	$ +618,000
	Seabrook Lock Unit	4,727,000	6,225,600	6,379,000	+153,400
	Subtotal	$ 8,284,000	$10,917,600	$11,689,000	$ +771,400
08	Roads:				
	New Orleans East Unit	$ 302,000	$ 399,000	$ 399,000	-
	Subtotal	$ 302,000	$ 399,000	$ 399,000	-
09	Channels and canals:				
	New Orleans East Unit	$ 5,909,000	$ 7,867,000	$ 7,927,400	$ +60,400
	Subtotal	$ 5,909,000	$ 7,867,000	$ 7,927,400	$ +60,400
11	Levees and floodwalls:				
	New Orleans East Unit	*$29,384,000	*$45,012,000	*$53,096,200	*$+8,084,200
	New Orleans West Unit	5,401,000	7,117,000	7,117,000	-
	Mandeville Unit	196,000	258,000	258,000	-
	Subtotal	$34,981,000	$52,387,000	$60,471,200	$+8,084,200
15	Control structures:				
	New Orleans East Unit	$ 7,680,000	$10,106,000	$10,473,000	$ +367,000
	Subtotal	$ 7,680,000	$10,106,000	$10,473,000	$ +367,000

*Does not include cost for foreshore protection along MR-GO.

TABLE 8 (cont'd)

	Feature	Project document	PB-3 eff. 1 Jul 67	Design Memo No. 2	Difference DM No. 2 - PB-3
30	Engineering and design:				
	New Orleans East Unit	$ 2,168,000	$ 5,409,000	$ 6,173,100	$ +764,100
	New Orleans West Unit	220,000	736,000	736,000	-
	Seabrook Lock Unit	265,000	478,400	491,000	+12,600
	Mandeville Unit	12,000	39,000	39,000	-
	Subtotal	$ 2,665,000	$ 6,662,400	$ 7,439,100	$ +776,700
31	Supervision and administration:				
	New Orleans East Unit	$ 3,141,000	$ 4,600,000	$ 5,264,100	$ +664,100
	New Orleans West Unit	329,000	547,000	547,000	-
	Seabrook Lock Unit	388,000	456,000	460,000	+4,000
	Mandeville Unit	16,000	31,000	31,000	-
	Subtotal	$ 3,874,000	$ 5,634,000	$ 6,302,100	$ +668,100
	Lands and damages:				
	New Orleans East Unit	$ 4,257,000	$ 5,213,000	$13,651,900	$+8,438,900
	New Orleans West Unit	222,000	305,000	809,500	+504,500
	Subtotal	$ 4,479,000	$ 5,518,000	$14,461,400	$+8,943,400
	Relocations:				
	New Orleans East Unit	$ 512,000	$ 792,000	$ 1,643,800	$ +851,800
	New Orleans West Unit	36,000	45,000	194,000	+149,000
	Subtotal	$ 548,000	$ 837,000	$ 1,837,800	$+1,000,800
	Total cost	$68,722,000	$100,328,000	$121,000,000	$+20,672,000

SCHEDULES FOR DESIGN AND CONSTRUCTION

CITRUS BACK LEVEE

93. The sequence of contracts and the schedule for design and construction are shown below:

Contracts	*Design		Construction			Estimated construction cost (including contingencies)
	Start	Complete	Advertise	Award	Complete	
Levee, 1st lift (Sta. 176+75.9 to Sta. 431+00)	Sep 67	Feb 68	Feb 68	Mar 68	Dec 68	**$1,326,000
Floodwall (Sta. 571+00 to Sta. 584+00)	Jul 67	Dec 67	Feb 68	Mar 68	Jun 68	210,000
Floodwall (Sta. 430+95 to Sta. 454+80 and Sta. 253+35 to Sta. 271+55)	Jul 67	Dec 67	Apr 69	May 69	Jun 70	980,800
Levee, 1st lift (Sta. 507+44.6 to Sta. 571+60)	Jan 68	May 68	Jun 68	Jul 68	Dec 68	566,000

*Includes general design memorandum and plans and specifications for the period from start to final approval.

**Includes an expenditure of $341,800 by the Orleans Levee District to raise the levee during calendar year 1966 to a gross grade of 13.0 feet m.s.l. between IHNC and Paris Road. The value of the work will be credited to the Levee District in accordance with the conditions of local cooperation and the understanding contained in exchange of correspondence between the Levee District and the Corps of Engineers. (See Appendix B.)

SCHEDULES FOR DESIGN AND CONSTRUCTION (cont'd)

Contracts	Design		Construction			Estimated construction cost (including contingencies)
	Start	Complete	Advertise	Award	Complete	
Levee, 1st lift (Sta. 454+75 to Sta. 507+44.6)	Oct 68	Feb 69	Mar 69	Apr 69	Mar 70	$ 761,000
Levee, 1st lift (Sta. 584+18.6 to Sta. 664+73.3)	Oct 68	Feb 69	Mar 69	Apr 69	Apr 70	1,105,000
Levee, 2d lift (Sta. 176+75.9 to Sta. 431+00 and Sta. 507+44.6 to Sta. 571+60)	Aug 69	Nov 69	Nov 69	Dec 69	Jun 70	493,000
Levee, 2d lift (Sta. 454+75 to Sta. 507+44.6 and Sta. 584+18.6 to Sta. 664+73.3)	Aug 70	Dec 70	Dec 70	Jan 71	Nov 71	204,000
Levee, 3d lift (Sta. 176+75.9 to Sta. 664+73)	Apr 72	Jul 72	Jul 72	Aug 72	Jun 73	698,000
Levee, 4th lift and seeding (Sta. 176+75.9 to Sta. 664+73)	Dec 73	May 74	May 74	Jun 74	Mar 75	539,000

SCHEDULES FOR DESIGN AND CONSTRUCTION (cont'd)

Contracts	Design		Construction			Estimated construction cost (including contingencies)
	Start	Complete	Advertise	Award	Complete	
Foreshore protection (Sta. 176+75.9 to Sta. 507+45)	Jul 71	Oct 71	Oct 71	Nov 71	Jun 72	*$ 566,000
Foreshore protection (Sta. 507+45 to Sta. 664+73) Slope protection (Sta. 628+00 to Sta. 636+00)	Jul 71	Oct 71	Oct 71	Nov 71	Jun 72	386,200
TOTAL						$7,835,000

*To be funded under MR-GO project.

SCHEDULE FOR DESIGN AND CONSTRUCTION (cont'd)

To maintain the schedule for the Citrus Back Levee 1/ as shown above, Federal funds will be required by Fiscal Years as follows:

Estimated cost through F.Y.	1967	$ 126,645
Appropriation required	1968	691,000
	1969	2,153,000
Local cash-	1970	1,958,000
	1971	167,800
	1972	416,600 2/
	1973	624,400
	1974	75,100
	1975	356,055
TOTAL		$6,568,600

Notes:

1/ a. The overall project will be constructed with Federal funds of $81,983,500 and non-Federal funds and equivalent work having an estimated aggregate value of $22,717,300, respectively. Inasmuch as local interests have indicated that they will provide the required contribution in installments proportional to Federal appropriations rather than in lump sum, for each dollar of Federal funds appropriated for construction, the Orleans Levee District will have to provide $\frac{\$22,717,300}{\$81,983,500}$ or $0.277. This will amount to 21.7% of the total construction.

b. The Orleans Levee District expended a total of $1,568,813.37 prior to F.Y. 1968, and is expected to expend an estimated additional $2,410,800 in F.Y. 1968 for construction of project improvements on the west bank of the Inner Harbor Navigation Canal between Florida Avenue and the IHNC Lock. The value of the above work will be credited to the Levee District under the terms of local cooperation and the understanding expressed in exchange of correspondence between the Levee District and the Corps of Engineers. (See Appendix B.) Final determination of the value of the work has not been made; for this memorandum, however, it has been assumed that the value is equal to the expenditure.

SCHEDULE FOR DESIGN AND CONSTRUCTION (cont'd)

c. Based on current planning schedules it has been determined that construction funds in the amounts of $5,436,400, $6,326,000, and $23,815,000, can be utilized on the Lake Pontchartrain Barrier Plan in Fiscal Years 1968, 1969, and 1970, respectively. Total Federal expenditures for the Barrier Plan through F.Y. 1967 were $1,348,700.

d. The above schedule of required Federal funds was developed by assuming that local interests would contribute no cash toward construction of any feature of the Barrier Plan until the accrued value of their equivalent work was exhausted; and subsequently would provide 21.7% of all construction funds required. The following table shows the determination of the year in which the value of non-Federal equivalent work will be exhausted (1970). It was further assumed that the local cash provided would be applied in the same proportions to all project features.

2/ Does not include $653,000 for foreshore protection to be funded under MR-GO project.

TABLE 9
LAKE PONTCHARTRAIN BARRIER PLAN
SCHEDULE OF REQUIRED FEDERAL AND NON-FEDERAL CONSTRUCTION FUNDS

Fiscal Year	Total Funds $	Theor. Req. Fed. Funds $	Theor. Req. Non-Fed. Funds $	Cum. Theor. Req. Fed. Funds $	Cum. Theor. Req. Non-Fed. Funds $	Act. Non-Fed. Contribution $	Act. Req. Fed. Funds $	Cum. Act. Fed. Req. $	Cum. Act. Non-Fed. Cont. $	Cum. Tot. Funds $
Through 1967	2,917,500	2,284,500	633,000	2,284,500	633,000	1,568,800 1/	1,348,700	1,348,700	1,568,800	4,917,500
1968	5,436,400	4,256,800	1,179,600	6,541,300	1,812,600	2,410,800 2/	3,025,600	4,374,300	3,979,600	8,353,900
1969	6,326,000	4,953,400	1,372,600	11,494,700	3,185,200	0	6,326,000	10,700,300	3,979,600	14,679,900
1970	23,815,000	18,647,800	5,167,200	30,142,500	8,352,400	4,372,800	19,442,200	30,142,500	8,352,400	38,494,900
After 1970	66,205,900	51,841,000	14,364,900	81,983,500	22,717,300	14,364,900	51,841,000	81,983,500	22,717,300	104,700,800

1/ Equivalent work by Orleans Levee District - various locations in Orleans Parish.

2/ Equivalent work to be accomplished by Orleans Levee District in F.Y. 1968 - Floodwall construction on the west bank of the IHNC between Florida Avenue and the IHNC Lock.

Par 94.

OPERATION AND MAINTENANCE

94. General. The physical operation and maintenance of all project features, with the exception of the two lock structures and the Rigolets navigation channel, will be the responsibility of local interests. The Seabrook Lock will be maintained and operated by and at the expense of the United States as a feature of the Mississippi River-Gulf Outlet project. The Rigolets lock and channel will be maintained and operated by the United States; the costs involved will, however, be borne by local interests who will provide a cash contribution equal to the capitalized value of the estimated annual operation and maintenance charge for the lock. This contribution will be applied to construction of the lock.

95. The estimated annual operation and maintenance, and replacement costs, for the Lake Pontchartrain Barrier Plan, are shown in Tables 9 and 10, respectively.

TABLE 10
LAKE PONTCHARTRAIN BARRIER PLAN
ESTIMATE OF ANNUAL OPERATION AND MAINTENANCE COST

	Federal	Non-Federal
Rigolets barrier structures	$125,000	$ 16,000
Chef Menteur barrier structures	-	63,400
St. Charles Parish	-	9,900
Jefferson Parish	-	700
Citrus (other than Citrus Back Levee)	-	4,100
New Orleans East	-	9,800
Barrier levee	-	20,800
Mandeville	-	1,200
Total	$125,000	$125,900

TABLE 11
LAKE PONTCHARTRAIN BARRIER PLAN
ESTIMATE OF ANNUAL REPLACEMENT COST

New Orleans (Inner Harbor Navigation Canal sheet piling)	$ 61,030
Citrus (Inner Harbor Navigation Canal sheet piling)	45,500
Mandeville (seawall)	4,700
Total	$111,230 1/

1/ Comprised of replacement costs shown in project document escalated to reflect July 1967 price levels; except that project document replacement costs for IHNC West Levee between Florida Avenue and IHNC Lock were eliminated due to replacing the "sheet piling wall with concrete cap" provided in the project document with "I"-type floodwall or connected "T"-type floodwall, and that replacement costs shown in Design Memorandum No. 2 - General, Advance Supplement, IHNC West Levee, Florida Avenue to IHNC Lock," were added.

96. Citrus Back Levee. The Citrus Back Levee, exclusive of the foreshore protection along the Mississippi River-Gulf Outlet, will be maintained and operated at the expense of local interests as a feature of local cooperation of the hurricane project. The foreshore protection along the Mississippi River-Gulf Outlet is properly a feature of the Mississippi River-Gulf Outlet project and maintenance costs for such protection are chargeable to that project. A detailed estimate of the annual operations and maintenance costs of the Citrus Back Levee is shown in Table 12. In addition, it is estimated that replacement of the overhead roller gates will be necessary at 30-year intervals. The annual charge for these replacements is $525.

TABLE 12
CITRUS BACK LEVEE
ESTIMATE OF ANNUAL OPERATION AND MAINTENANCE COSTS

	Federal	Non-Federal
Maintenance:		
Levee	$ -	$4,690
I-wall	-	350
Foreshore protection	3,120*	1,470
Overhead roller gates	-	705

Par 96.

TABLE 12 (cont'd)

	Federal	Non-Federal
Operation:		
Overhead roller gates	$ -	$ 30
Total	$3,120	$7,245

* Chargeable to the Mississippi River-Gulf Outlet project.

ECONOMICS

97. General. The Citrus Back Levee is not an independent element of the Lake Pontchartrain Barrier Plan, and an independent economic analysis for the levee is not practicable. Because the four units which comprise the barrier plan, i.e. New Orleans East, New Orleans West, Seabrook, and Mandeville are all dependent for protection upon the Lake Pontchartrain Barrier, an independent economic evaluation of each of these units is likewise impracticable. The economic coverage herein accordingly, refers to the barrier plan as a whole. The benefit data were obtained by simple updating of the analyses contained in the survey report, with the addition of the benefits to be realized as a result of the relocation of the Lake Pontchartrain Barrier.

98. Benefits.

a. The Lake Pontchartrain Barrier Plan will provide essentially complete protection from hurricane flood to 101,700 acres of land in the parishes of Orleans, Jefferson, St. Charles, and St. Tammany. The total area involved comprises 25,100 acres of urban-type development, 30,200 acres of open land, 40,200 acres of woodland and swamp, and 6,200 acres of lands of miscellaneous development. In addition, the operation of the barrier will serve to ameliorate, in varying degrees, hurricane flooding on 350,200 acres of land peripheral to Lake Pontchartrain and outside the project protective levees. The value of 31,500 acres now subject to overflow by normal high tides will be enhanced.

b. Average annual monetary benefits attributable to the prevention of flood damage on present and future development will be $17,924,700 and $48,026,000, respectively, for an aggregate of $65,951,400. Enhancement of existing land values will add another $358,600 annually, bringing the total benefit to $66,310,000 annually, based on current price levels. (1 July 1967)

c. The increase in total benefit over the value contained in the project document reflects the increase in the severity of hurricane parameters discussed elsewhere in this report; the increase in price levels; increased level of development in the protected areas; and the addition of benefits realized as a result of the relocation of the barrier.

99. Annual charges. Details of the annual charges for the Lake Pontchartrain Barrier Plan of $4,922,800 are shown in Table 13:

TABLE 13
LAKE PONTCHARTRAIN BARRIER PLAN
ESTIMATE OF ANNUAL ECONOMIC COST

Summary of project costs	Federal	Non-Federal	Total
Construction	$104,700,800		$104,700,800
Lands, damages, relocations	-	$16,299,200	16,299,200
	$104,700,800	$16,299,200	$121,000,000
Cash contribution	-22,717,300	22,717,300	-
First cost	$ 81,983,500	$39,016,500(1)	$121,000,000
Interest during construction	6,971,500	2,913,500	9,885,000
Total project investment	$88,955,000	$41,930,000	$130,885,000
Annual economic costs			
Interest (3.125%)	$ 2,779,800	$ 1,310,300	$ 4,090,100
Amortization (2)	180,200	71,400	251,600
Maintenance and operation	125,000 (3)	133,100	258,100
Replacements		111,200	111,200
Economic loss on lands		211,800	
Total annual economic cost	$ 3,085,000	$ 1,837,800	$ 4,922,800

(1) Includes $3,816,000 for capitalized cost of OM&R Rigolets Lock.
(2) Seabrook Lock amortized in 50 years; all others in 100 years.
(3) OM&R of Rigolets Lock

100. Economic justification. The average annual benefits of $66,310,000 and average annual charges of $4,922,800 result in a favorable benefit-cost ratio of 13.5 to 1.

RECOMMENDATIONS

101. Recommendations. The plan of improvement presented herein for the Citrus Back Levee consists of levee enlargement from the IHNC to vicinity of the bulk loading facilities, thence floodwall in a levee enlargement across the Bulk Loading Facilities of the Board of Commissioners of the Port of New Orleans, thence levee enlargement to Paris Road, thence floodwall in a levee enlargement through the Michoud Steam Electric Generating Plant of the New Orleans Public Service, Inc., thence levee enlargement to the intersection of the GIW and the Michoud Canal, thence floodwall in a levee enlargement along the Michoud Canal for approximately 1,300 feet, thence levee enlargement to the north end of the Michoud Canal. This plan is considered to be the best means of accomplishing the project objectives and is recommended for approval.

LAKE PONTCHARTRAIN

ORLEANS PARISH

Little Woods

Citrus

SOUTHERN RAILROAD

N.O. AIRPORT.

DOMINICAN ROAD

MORRISON ROAD

OLD GENTILLY ROAD

LOUISVILLE AND NASHVILLE RAILROAD

INNER HARBOR NAVIGATION CANAL

MISSISSIPPI RIVER-GULF OUTLET

PLATE 2

AND

3

Eleven Mile Post

PARIS ROAD

ST. HWY. 47 BRIDGE

Bienvenue

Bayou

ORLEANS PARISH

ST. BERNARD PARISH

GULF

INTRACOASTAL

WATERWAY

M. R. - G. O.

NASA

Michoud Slip

4

MICHOUD CANAL

Michoud Canal

PLATE 5

LEGEND

Existing Levee

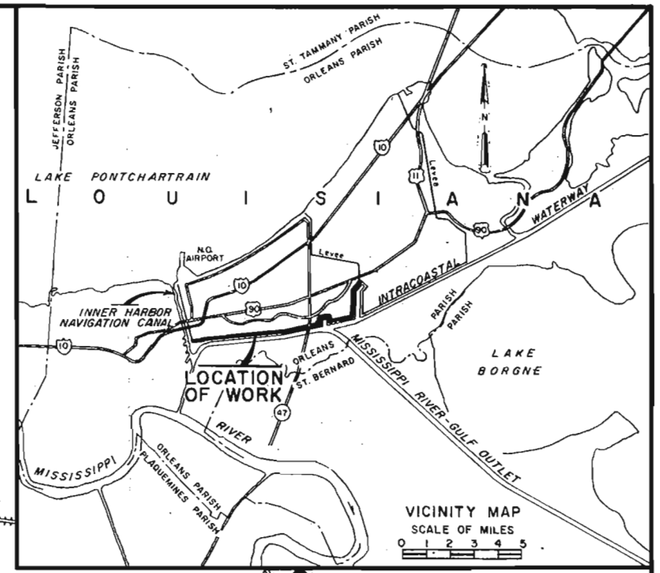
AUTHORIZED IMPROVEMENTS

Levee Enlargement

Floodwall

SCALE IN FEET

2000 1000 0 2000 4000



LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN

CITRUS BACK LEVEE

IHNC THRU NASA

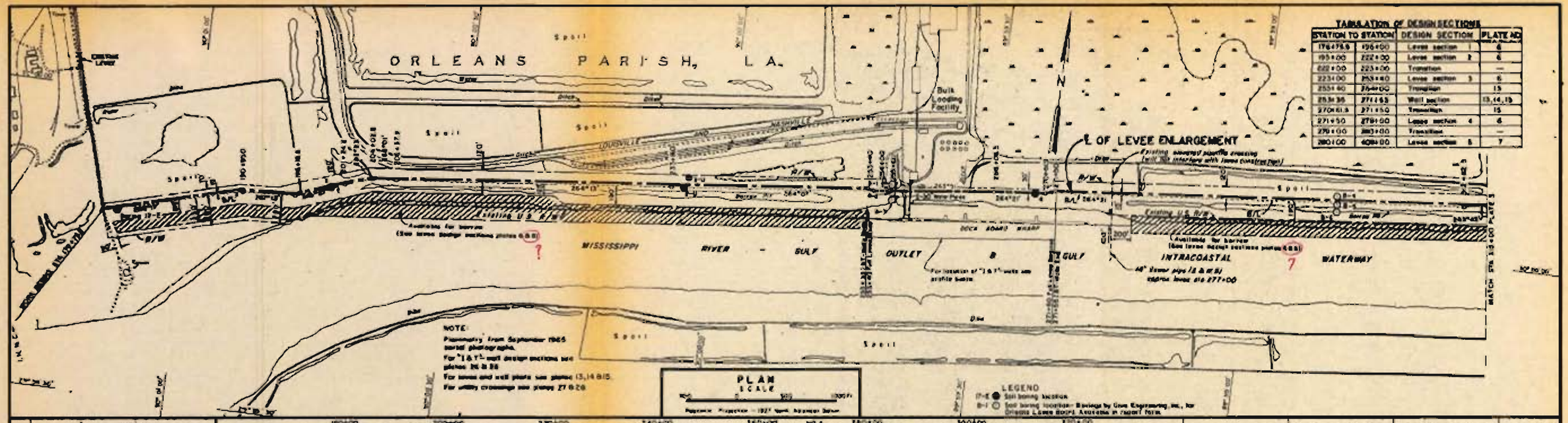
INDEX AND VICINITY MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967

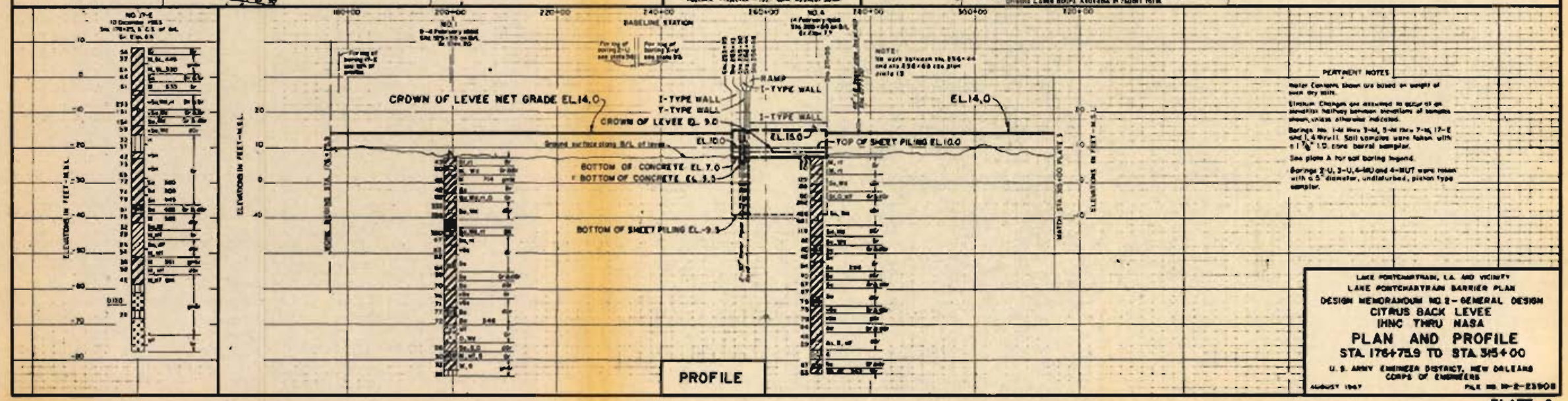
FILE NO. H-2-23908

PLATE 1



TABULATION OF DESIGN SECTIONS

STATION TO STATION		DESIGN SECTION	PLATE NO.
176+75.9	196+00	Levee section 1	6
196+00	222+00	Levee section 2	6
222+00	223+00	Transition	—
223+00	253+80	Levee section 3	6
253+80	256+00	Transition	15
256+35	271+63	Wall section	13,14,15
270+63.9	271+50	Transition	15
271+50	278+00	Levee section 4	6
278+00	280+00	Transition	—
280+00	404+00	Levee section 5	7



PERTINENT NOTES

Water Contents shown are based on weight of oven dry soils.

Elevation Changes are assumed to occur at an annualized halfway between elevations of borings shown, unless otherwise indicated.

Borings No. 1-M thru 3-M, 5-M thru 7-M, 17-E and 1-A thru 11 Soil samples were taken with a 1⅜" I.D. split barrel sampler.

See plate A for soil boring legend.

Borings 2-U, 3-U, 6-MU and 4-MUT were taken with a 5" diameter, undisturbed, piston type sampler.

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STA. 176+75.9 TO STA. 345+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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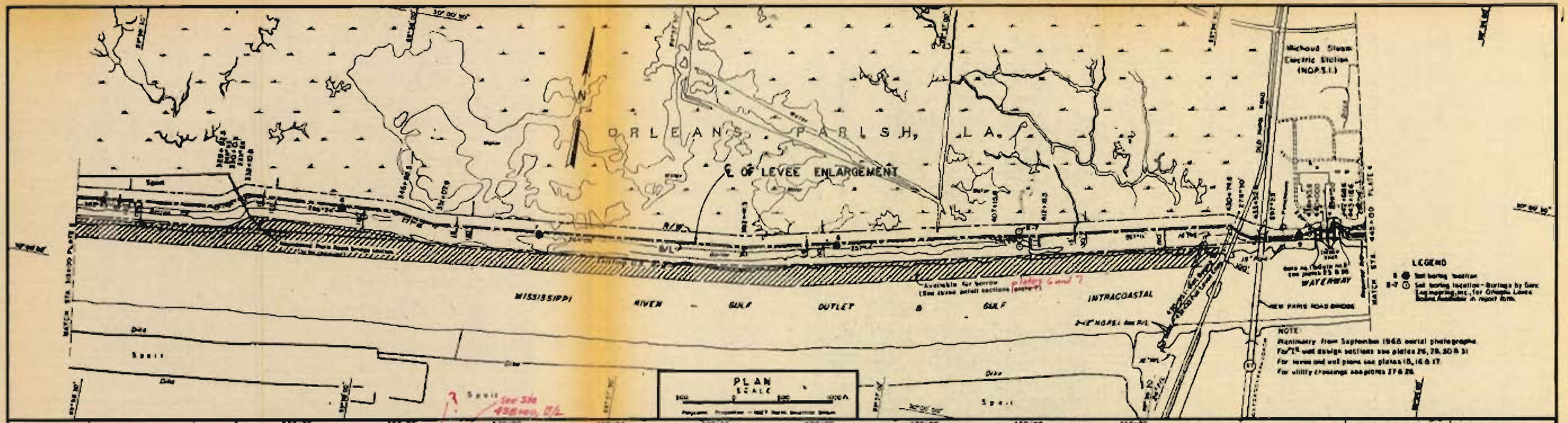
FILE NO. 30-2-23508

PLATE 2



TABULATION OF DESIGN SECTIONS

STATION TO STATION		DESIGN SECTION	PLATE NO
379+00	408+00	Levee Section 5	7
408+00	410+00	Transition	—
410+00	417+75	Levee Section 5	6
417+75	421+75	Transition	—
421+75	431+00	Levee Section 6	7
431+00	432+00	Transition	16
432+00	454+80	Wall Section	18, 17, 18

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STA. 315+00 TO STA. 445+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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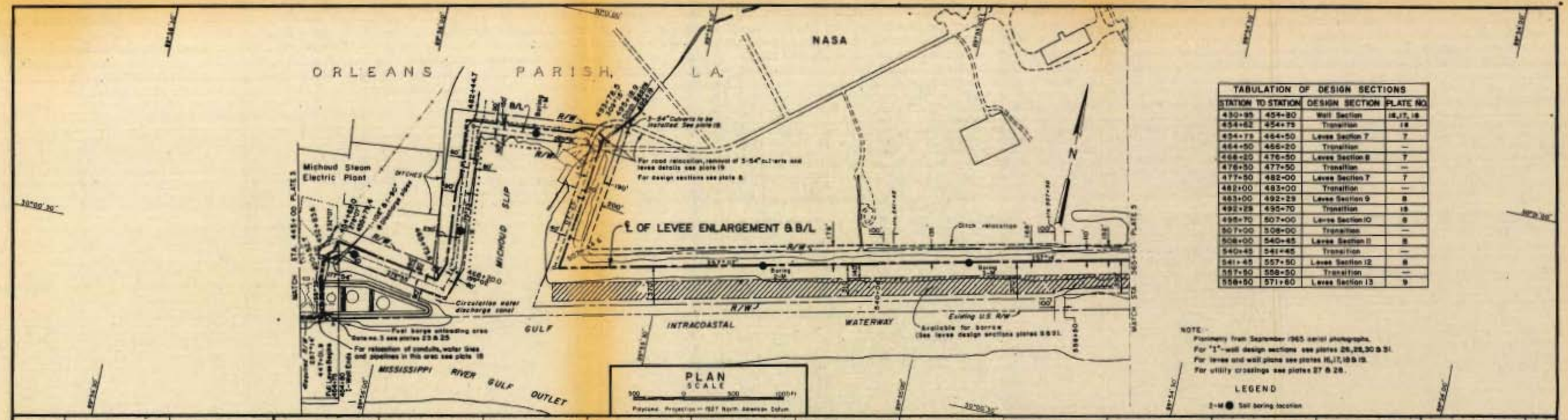
AUGUST 1967
FILE NO. N-2-23906

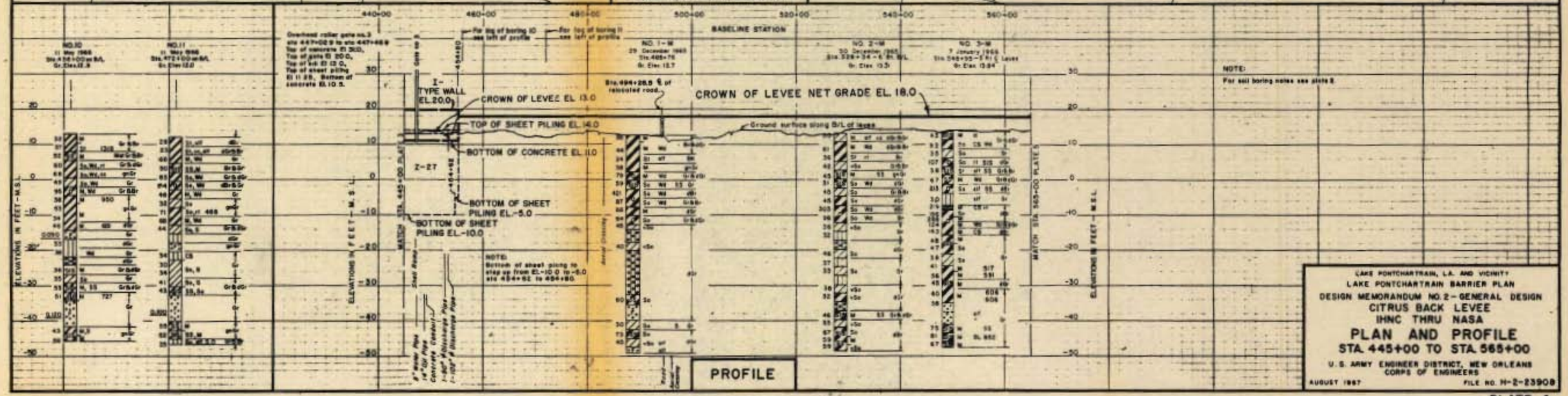
PLATE 3



TABULATION OF DESIGN SECTIONS			
STATION TO STATION		DESIGN SECTION	PLATE NO.
430+95	434+80	Wall Section	16,17, 18
434+82	454+75	Transition	18
454+75	464+50	Levee Section 7	7
464+50	466+20	Transition	—
466+20	476+50	Levee Section 8	7
476+50	477+50	Transition	—
477+50	482+00	Levee Section 7	7
482+00	483+00	Transition	—
483+00	492+29	Levee Section 9	8
492+29	495+70	Transition	18
495+70	507+00	Levee Section 10	8
507+00	508+00	Transition	—
508+00	540+45	Levee Section 11	8
540+45	541+45	Transition	—
541+45	557+50	Levee Section 12	8
557+50	558+50	Transition	—
558+50	571+60	Levee Section 13	9

NOTE:
Planimetry from September 1965 aerial photographs.
For "I"-wall design sections see plates 26, 28, 30 & 31.
For levee and wall plans see plates 16, 17, 18 & 19.
For utility crossings see plates 27 & 28.

LEGEND
2-M ● Soil boring location



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STA. 445+00 TO STA. 565+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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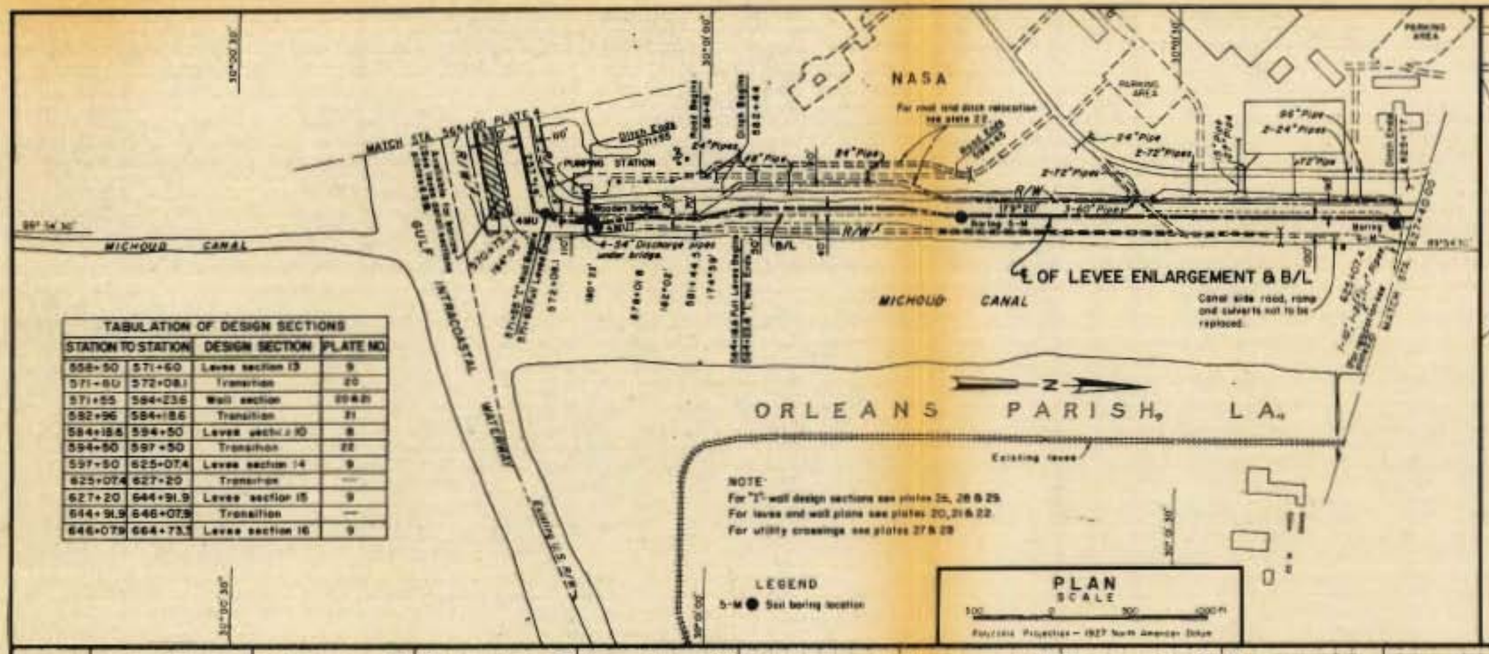
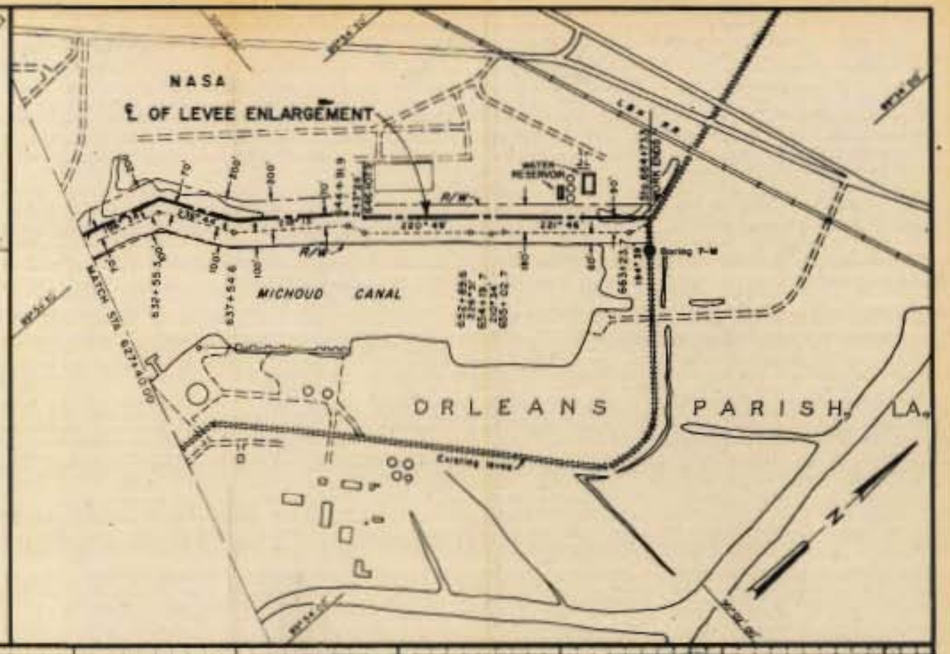
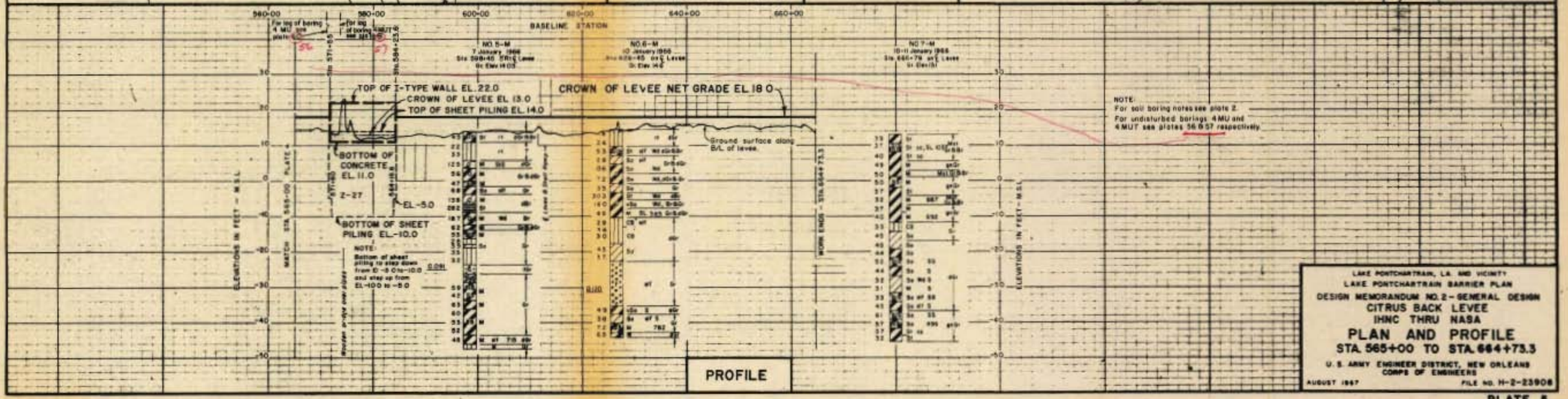
AUGUST 1967 FILE NO. H-2-23908

PLATE 4



TABULATION OF DESIGN SECTIONS			
STATION TO STATION		DESIGN SECTION	PLATE NO.
558+50	571+60	Levee section 13	9
571+60	572+08.1	Transition	20
571+55	584+23.6	Wall section	20 & 21
582+96	584+18.6	Transition	21
584+18.6	594+50	Levee section 10	8
594+50	597+50	Transition	22
597+50	625+07.4	Levee section 14	9
625+07.4	627+20	Transition	—
627+20	644+91.9	Levee section 15	9
644+91.9	646+07.9	Transition	—
646+07.9	664+73.3	Levee section 16	9





LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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STA. 565+00 TO STA. 664+73.3
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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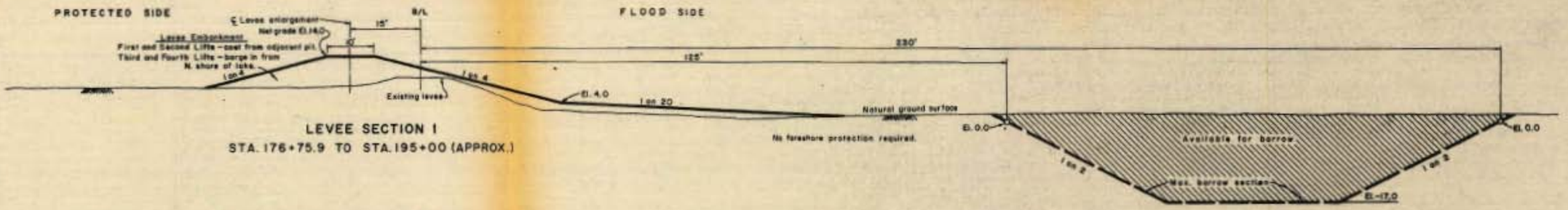
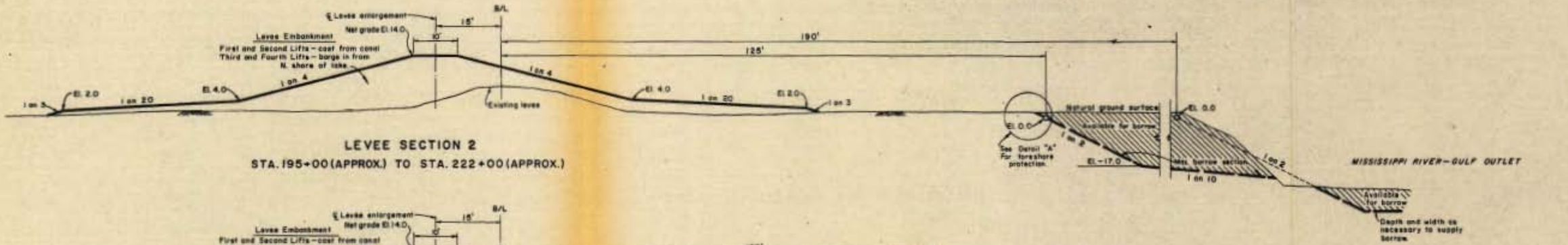
PLATE 5



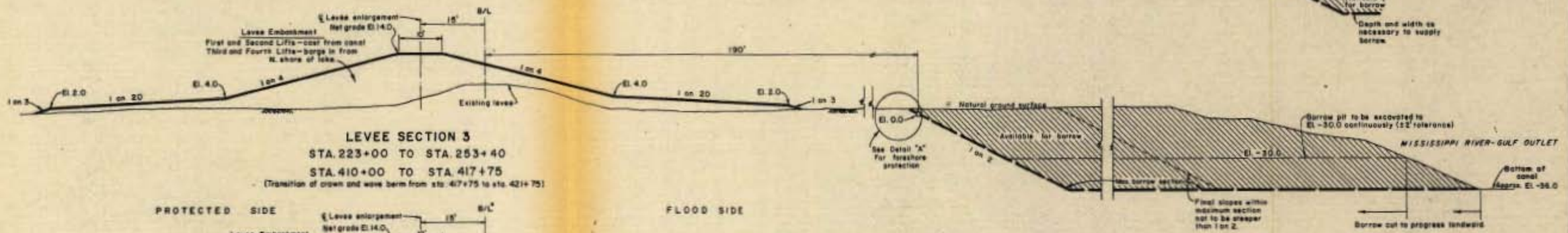
LEVEE SECTION 1

STA. 176+75.9 TO STA. 195+00 (APPROX.)



LEVEE SECTION 2

STA. 195+00 (APPROX.) TO STA. 222+00 (APPROX.)

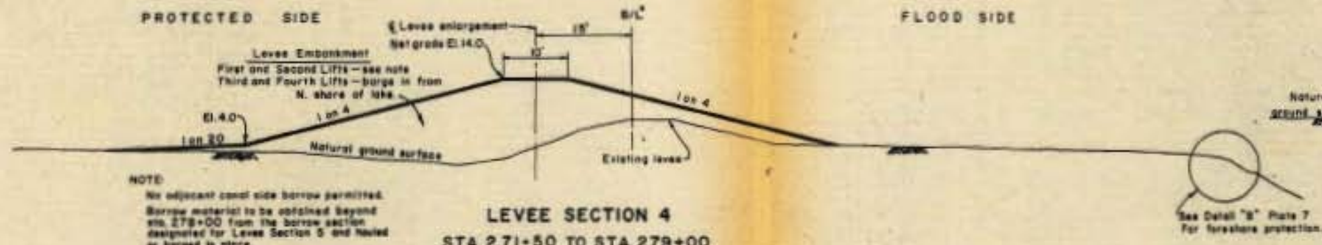


LEVEE SECTION 3

STA. 223+00 TO STA. 253+40

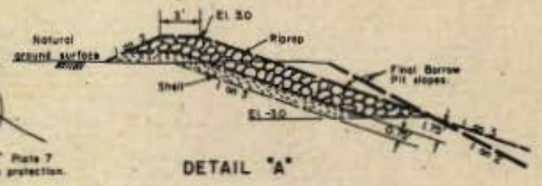
STA. 410+00 TO STA. 417+75

(Transition of crown and wave berm from sta. 417+75 to sta. 421+75)



LEVEE SECTION 4

STA. 271+50 TO STA. 279+00



DETAIL "A"

Sections plotted are not to scale.

For Plan and Profile see Plates 2 and 3.

LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

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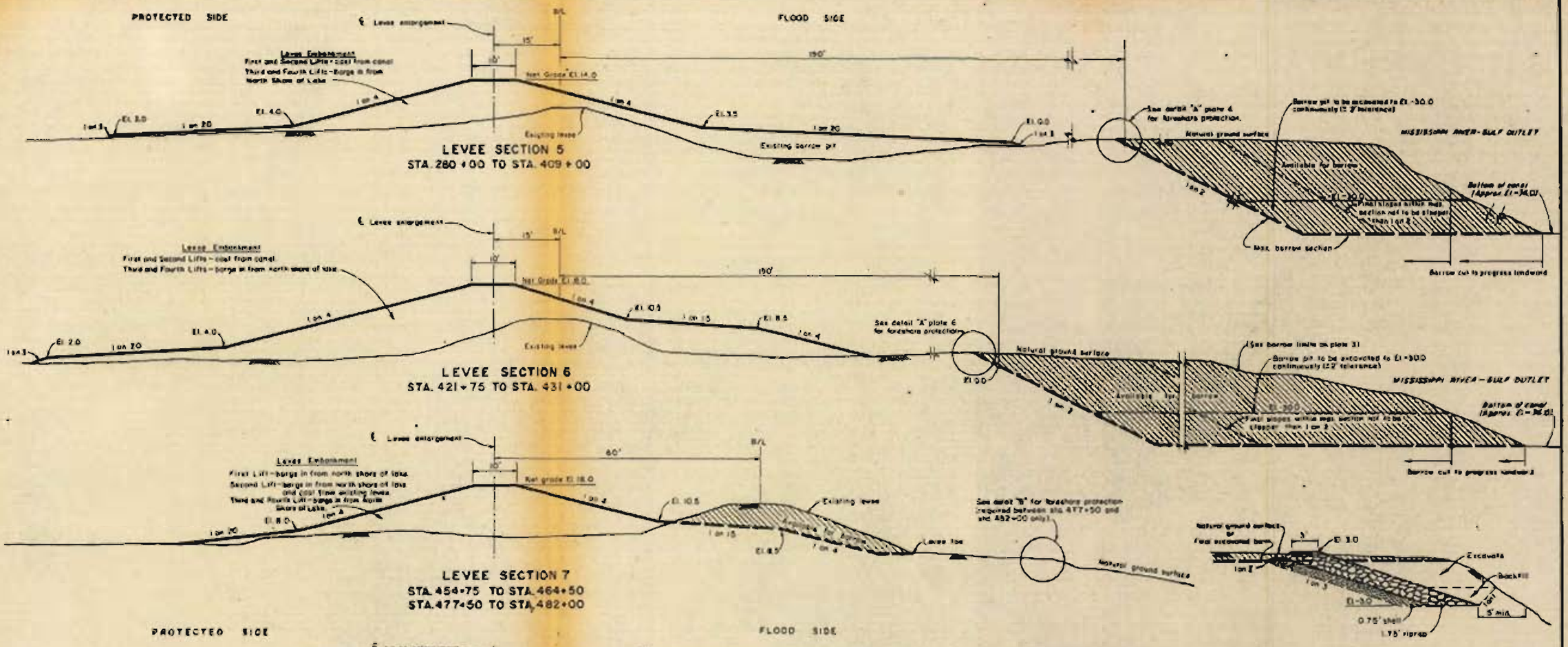
PLATE 6



LEVEE SECTION 5
STA. 280+00 TO STA. 409+00

LEVEE SECTION 6
STA. 421+75 TO STA. 431+00

LEVEE SECTION 7
STA. 454+75 TO STA. 464+50
STA. 477+50 TO STA. 482+00

LEVEE SECTION 8
STA. 466+20 TO STA. 476+50

DETAIL "B"

Sections plotted are not to scale.
For Plan and Profile see Plates 2, 3 and 4.

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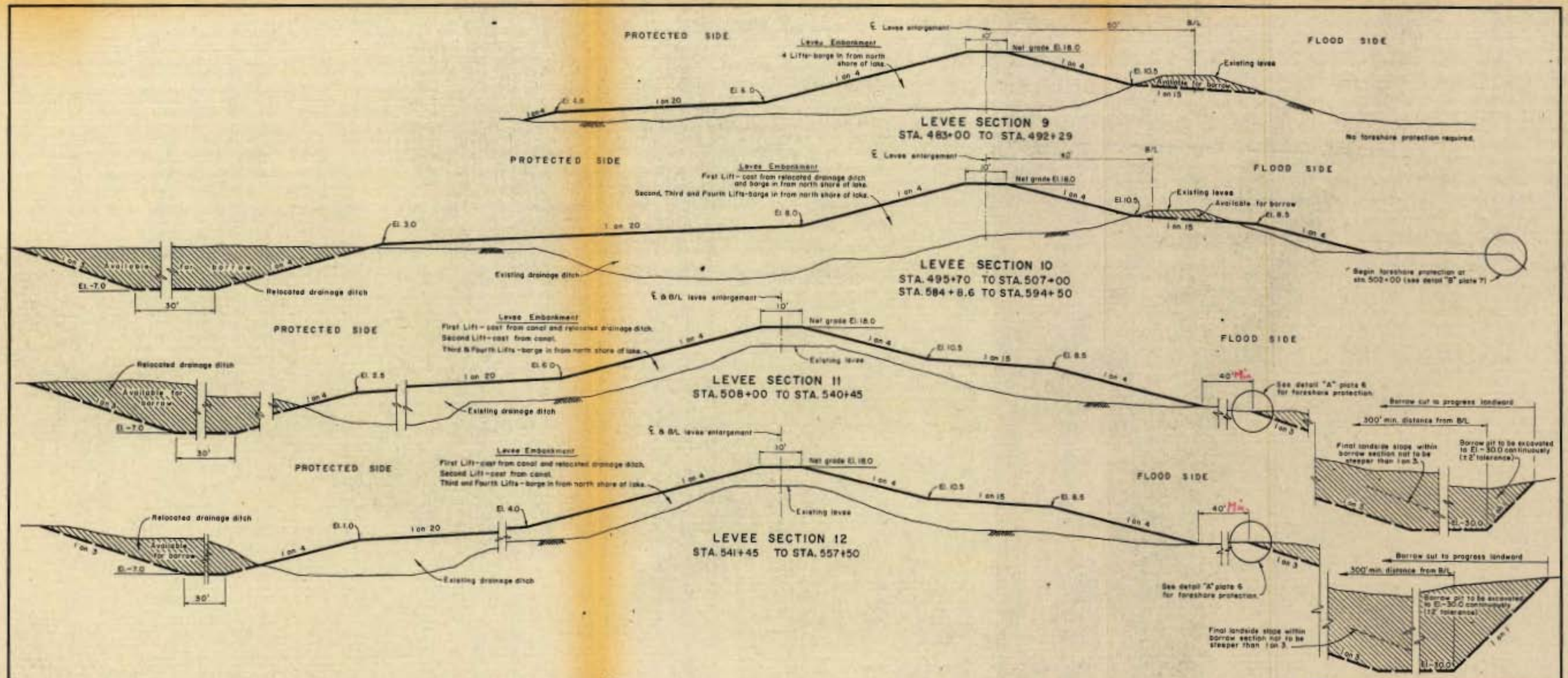
PLATE 7


PROTECTED SIDE
FLOOD SIDE
Levee Embankment
4 Lifts-barge in from north shore of lake.
℄ Levee enlargement
Net grade El. 18.0
Existing levee
Available for borrow
El. 10.5
El. 8.5
El. 8.0
El. 4.5
1 on 4
1 on 20
1 on 15
No foreshore protection required.
LEVEE SECTION 9
STA. 483+00 TO STA. 492+29
First Lift - cast from relocated drainage ditch and barge in from north shore of lake.
Second, Third and Fourth Lifts-barge in from north shore of lake.
El. 3.0
El. -7.0
30'
Relocated drainage ditch
Existing drainage ditch
* Begin foreshore protection at sta. 502+00 (see detail "B" plate 7)
LEVEE SECTION 10
STA. 495+70 TO STA. 507+00
STA. 584+8.6 TO STA. 594+50
℄ & B/L levee enlargement
First Lift - cast from canal and relocated drainage ditch.
Second Lift - cast from canal.
Third & Fourth Lifts - barge in from north shore of lake.
El. 2.5
El. 6.0
LEVEE SECTION 11
STA. 508+00 TO STA. 540+45
See detail "A" plate 6 for foreshore protection.
Borrow cut to progress landward
300' min. distance from B/L
Final landside slope within borrow section not to be steeper than 1 on 3.
Borrow pit to be excavated to El. -30.0 continuously (±2' tolerance)
El. -30.0
First Lift - cast from canal and relocated drainage ditch.
Second Lift - cast from canal.
Third and Fourth Lifts - barge in from north shore of lake.
El. 1.0
El. 4.0
LEVEE SECTION 12
STA. 541+45 TO STA. 557+50
Sections plotted are not to scale.
For Plan and Profile see Plates 4 and 5.
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DESIGN SECTIONS
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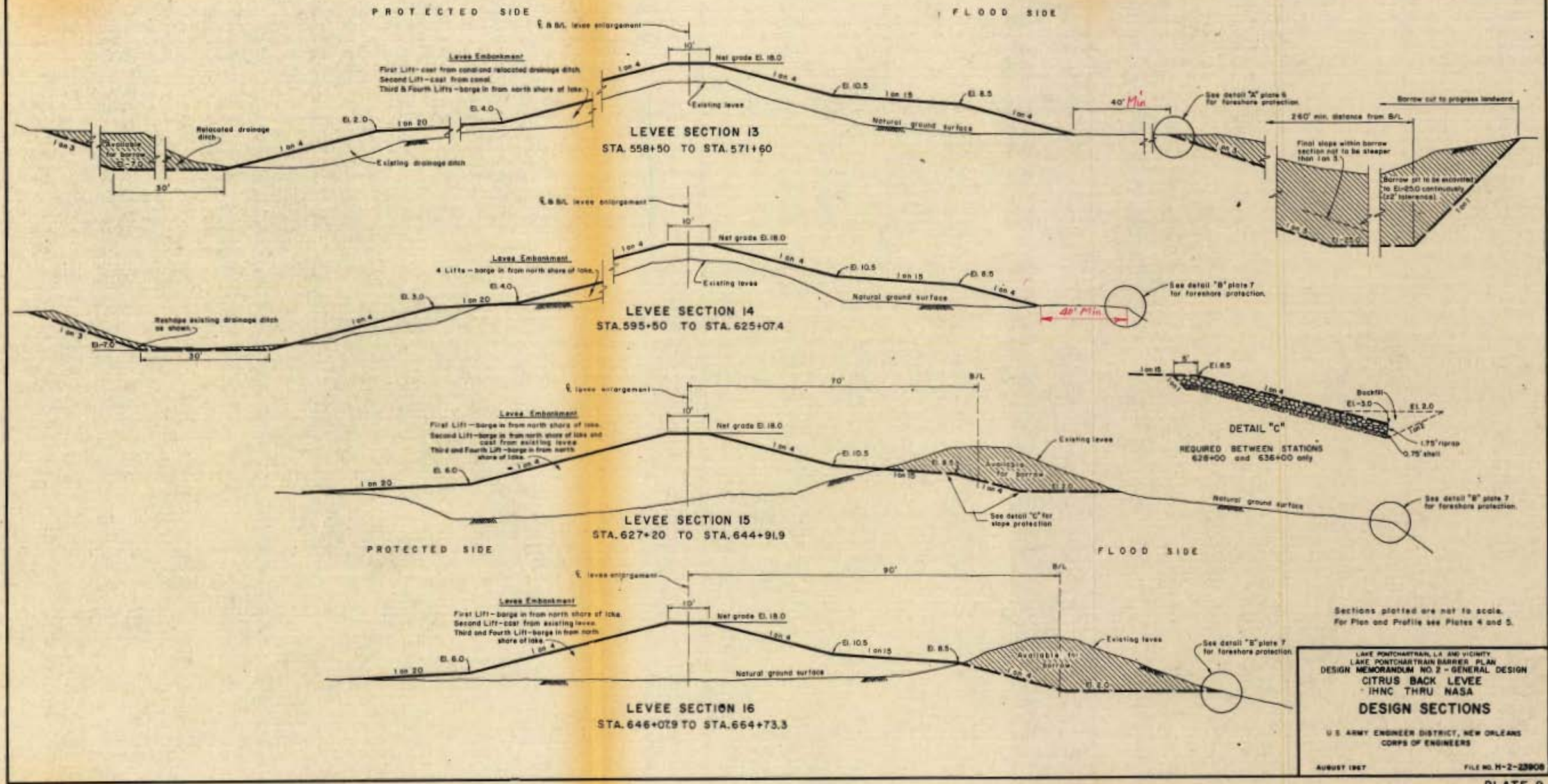
PLATE 8



Sections plotted are not to scale.
For Plan and Profile see Plates 4 and 5.

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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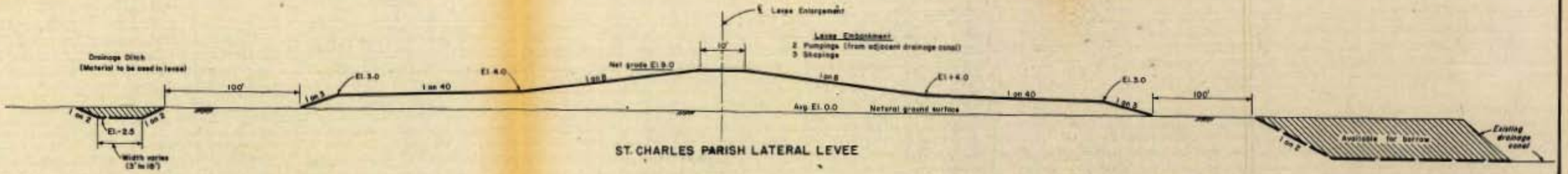
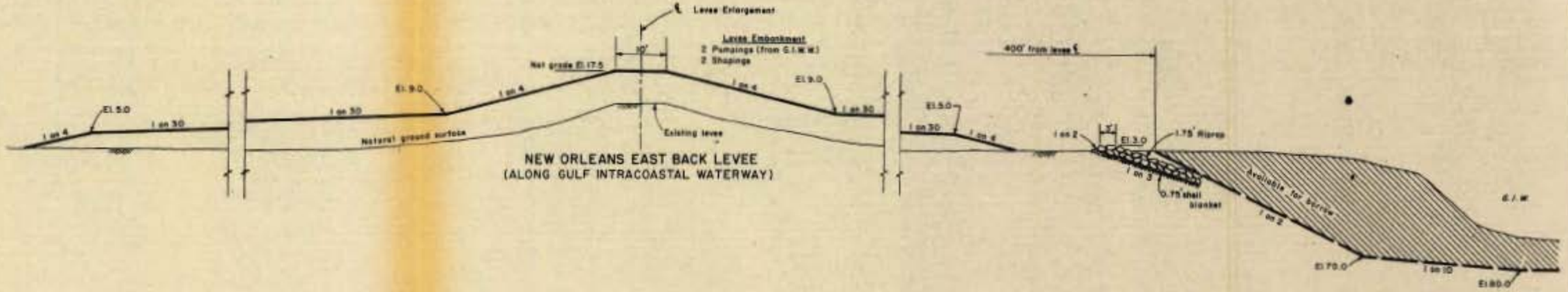
PLATE 9

PROTECTED SIDE

FLOOD SIDE



ST. CHARLES PARISH LATERAL LEVEE



NEW ORLEANS EAST BACK LEVEE
(ALONG GULF INTRACOASTAL WATERWAY)

NEW ORLEANS EAST BACK LEVEE
(ALONG MICHOUD CANAL)

Sections plotted are not to scale.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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TYPICAL SECTIONS
LEVEES OTHER THAN CITRUS BACK LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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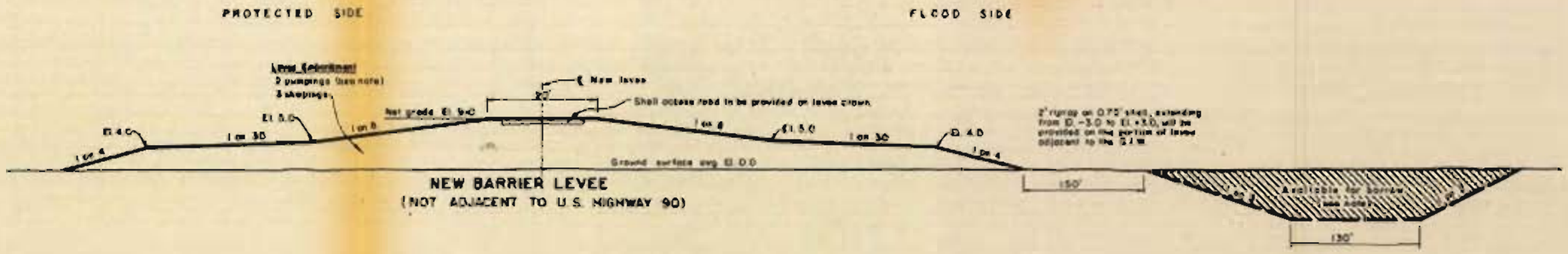
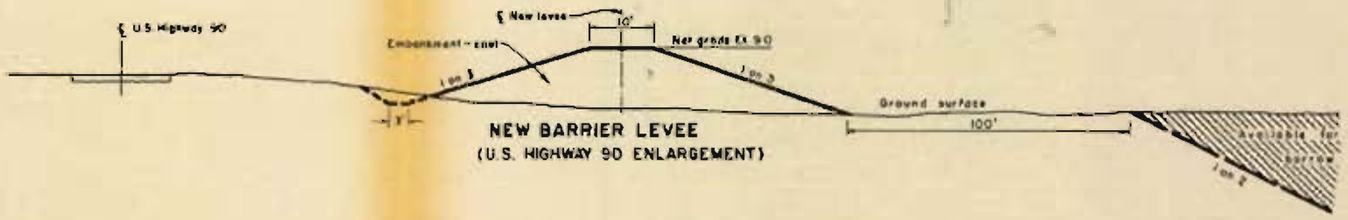
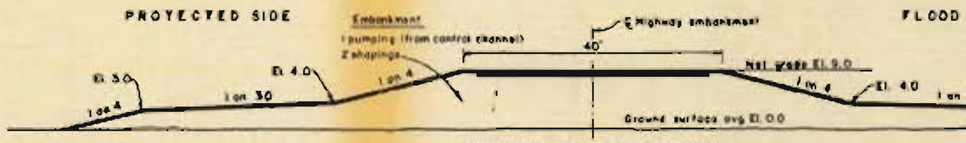
PLATE 10



NEW BARRIER LEVEE
(NOT ADJACENT TO U.S. HIGHWAY 90)



NEW BARRIER LEVEE
(U.S. HIGHWAY 90 ENLARGEMENT)



HIGHWAY 90 RELOCATION
EACH SIDE OF RIGOLETS CONTROL STRUCTURE

NOTE
Portions of the levee along the intracoastal waterway navigation and control channels shall be constructed with material required to be excavated from the channels in lieu of using the side borrow pit shown.

Sections plotted are not to scale.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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INNC THRU NASA

TYPICAL SECTIONS
LEVEES OTHER THAN CITRUS BACK LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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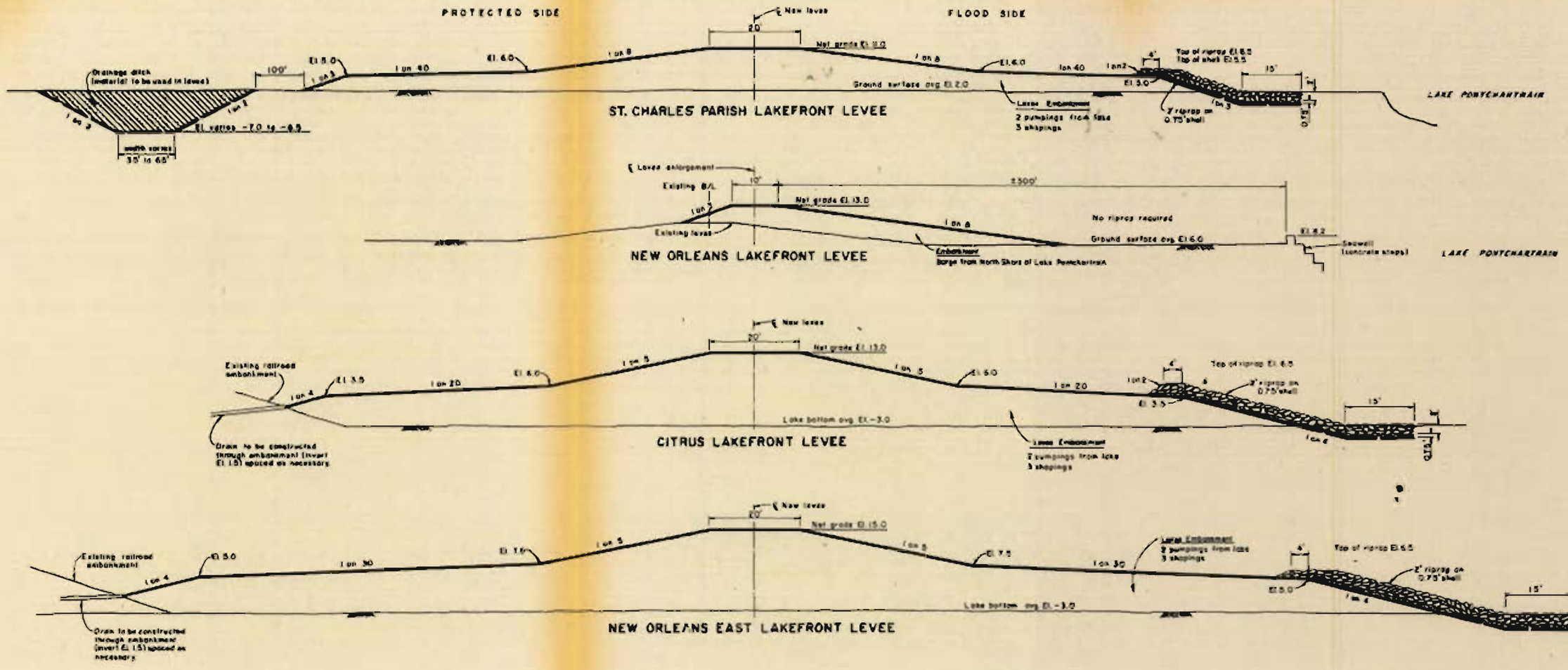
PLATE II



Sections plotted are not to scale.

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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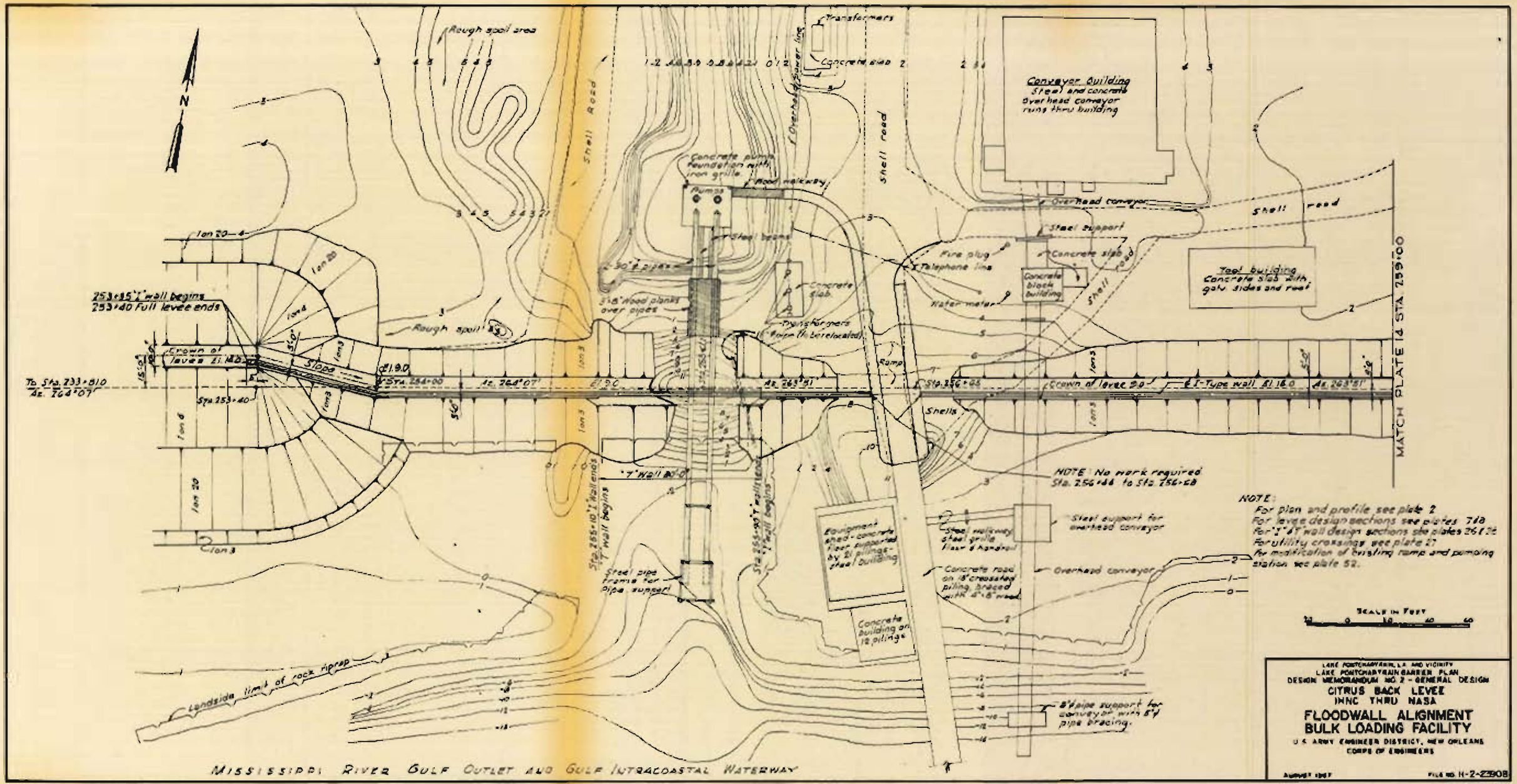
INNC THRU NASA

TYPICAL SECTIONS
LEVEES OTHER THAN CITRUS BACK LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. M-2-23906

PLATE 12



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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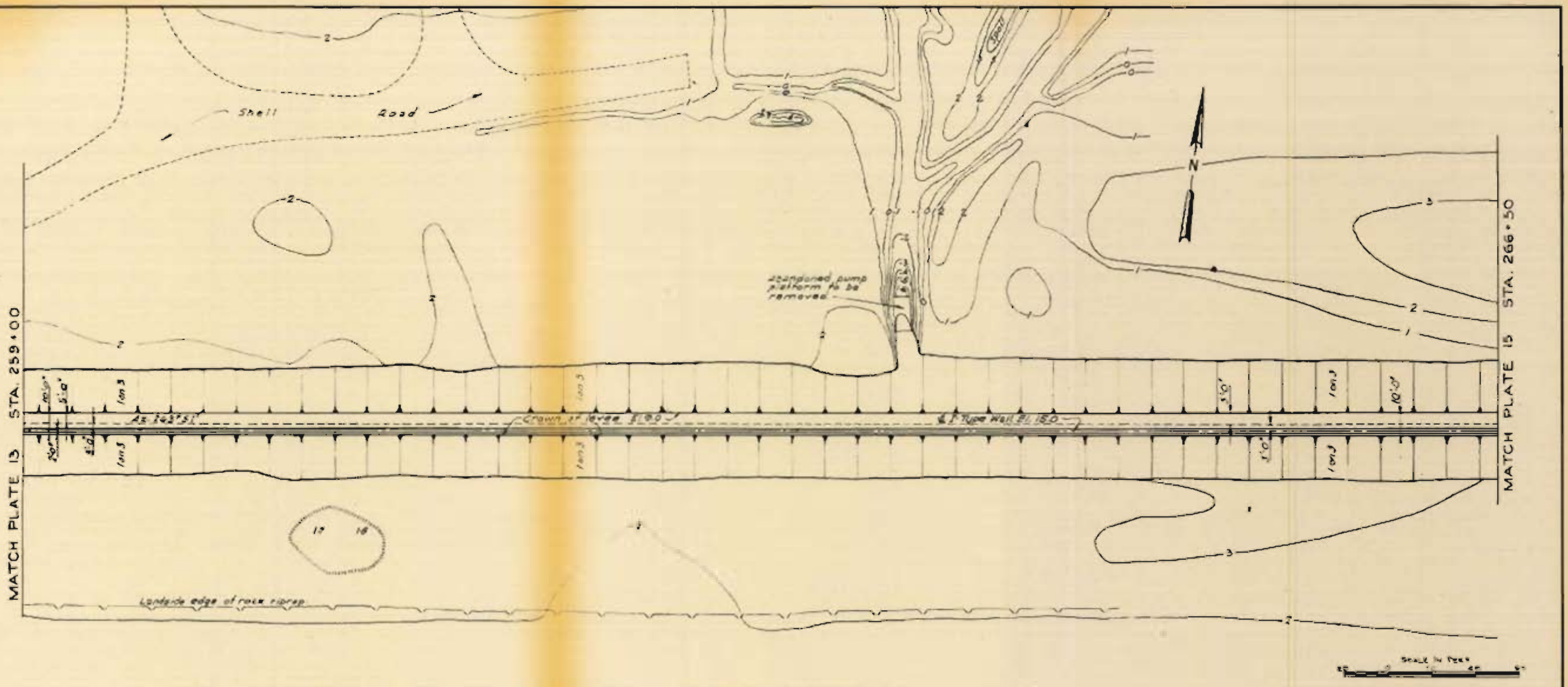
CITRUS BACK LEVEE
INNC THRU NASA

FLOODWALL ALIGNMENT
BULK LOADING FACILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-27908

PLATE 13



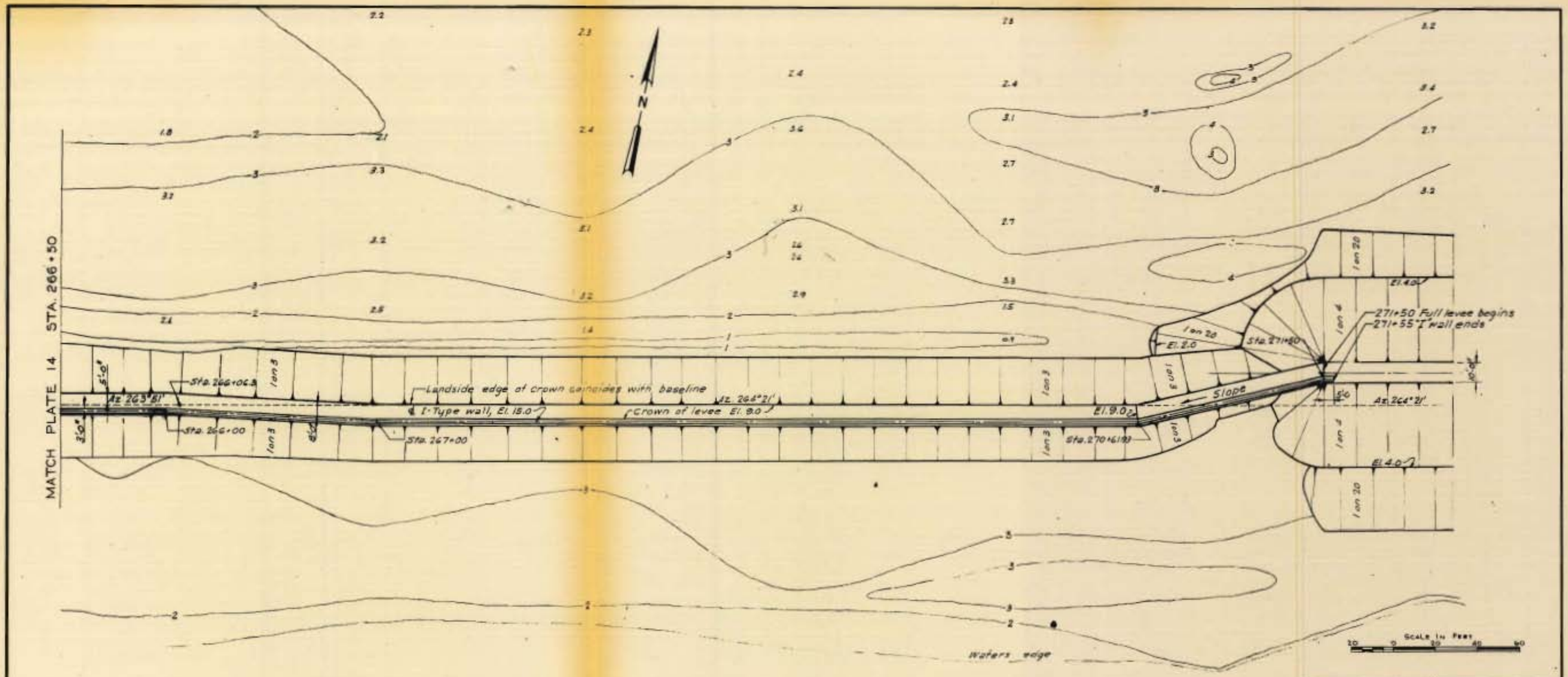
NOTES:
For plan and profile see plate 2.
For "T" wall design sections see plates 16 & 18

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
(NNC THRU NASA

FLOODWALL ALIGNMENT BULK LOADING FACILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967 FILE NO. H-2-23908

PLATE 14



MISSISSIPPI RIVER GULF OUTLET AND GULF INTRACOASTAL WATERWAY

NOTES:
For plan and profile see plate 2.
For "I" wall design sections see plates 26 & 28
For levee design sections see plate 6.

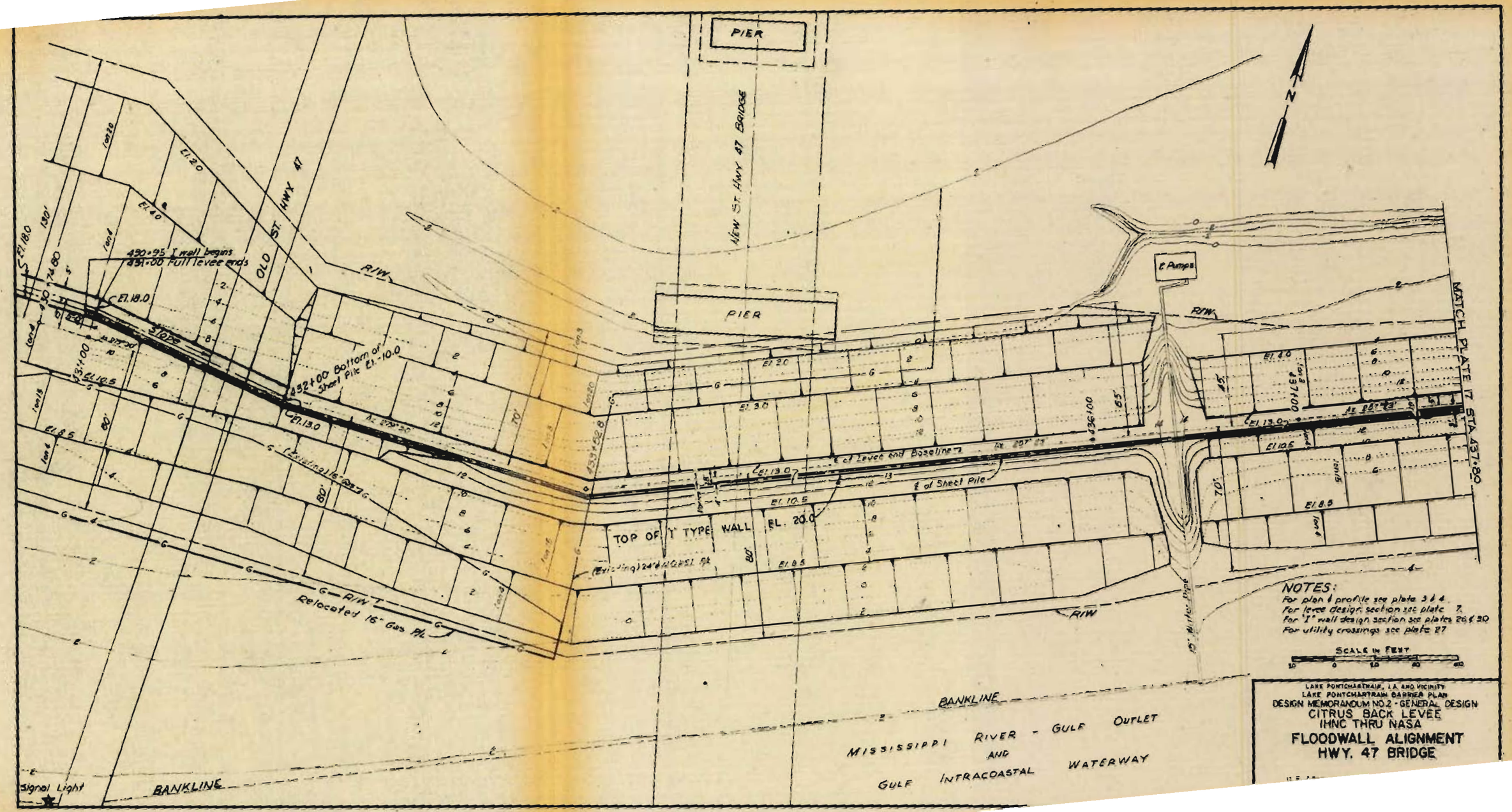
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

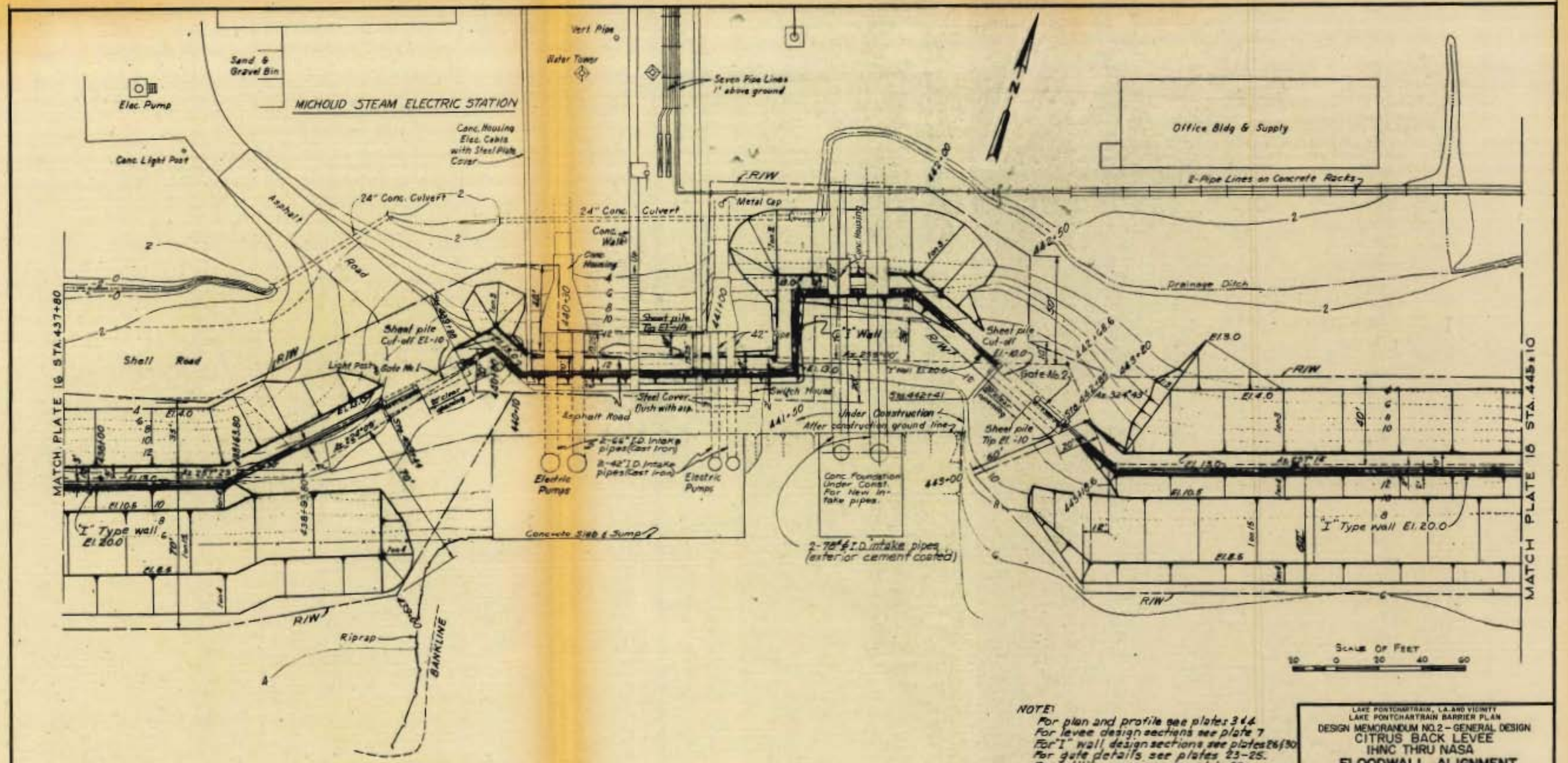
FLOODWALL ALIGNMENT BULK LOADING FACILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-23908

PLATE 15


PIER
NEW ST. HWY 47 BRIDGE
PIER
OLD ST. HWY 47
R/W
El. 20
El. 40
El. 18.0
Slope
430+95 T wall begins
431+00 Full levee ends
432+00 Bottom of Sheet Pile El. -10.0
El. 13.0
El. 10.5
El. 8.5
80'
70'
65'
45'
Existing 24" W.O.S.T. St.
Relocated 16" Gas Pl.
℄ of Levee and Baseline
℄ of Sheet Pile
TOP OF 'T' TYPE WALL EL. 20.0
℄ Pumps
MATCH PLATE 17 STA 437+80
10' Marine Drive
Signal Light
BANKLINE
BANKLINE
MISSISSIPPI RIVER - GULF OUTLET
AND
GULF INTRACOASTAL WATERWAY
N
NOTES:
For plan & profile see plate 3 & 4
For levee design section see plate 7
For 'T' wall design section see plates 26 & 30
For utility crossings see plate 27
SCALE IN FEET
10 0 10 20 40
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
FLOODWALL ALIGNMENT
HWY. 47 BRIDGE



MISSISSIPPI RIVER - GULF OUTLET AND GULF INTRACOASTAL WATERWAY

NOTE:
For plan and profile see plates 3 & 4.
For levee design sections see plate 7.
For "I" wall design sections see plates 26 & 30.
For gate details see plates 23-25.
For utility crossings see plate 27.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
FLOODWALL ALIGNMENT
MICHOUD STEAM ELECTRIC STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967 FILE NO. H-2-23908

PLATE 17

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

FLOODWALL ALIGNMENT
MICHOUD STEAM ELECTRIC STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-23908

PLATE 18

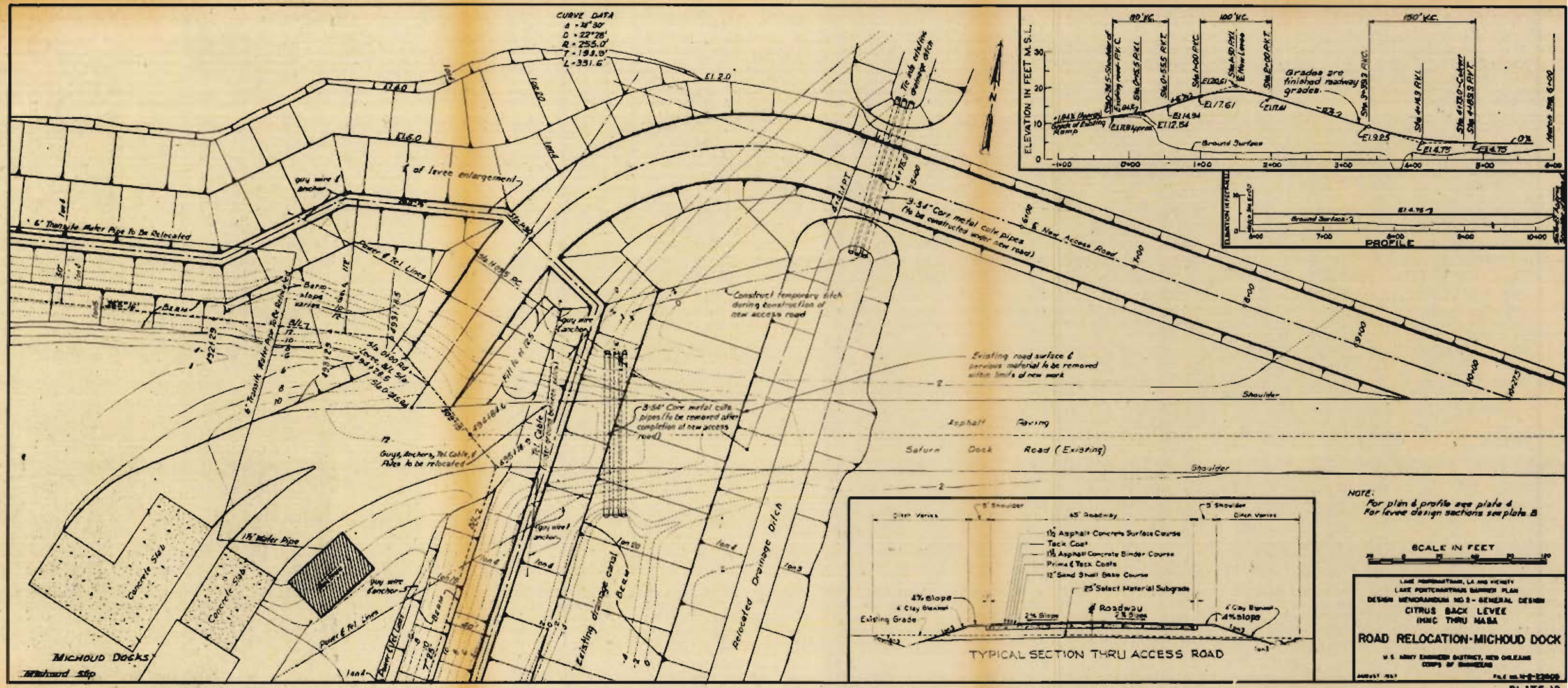
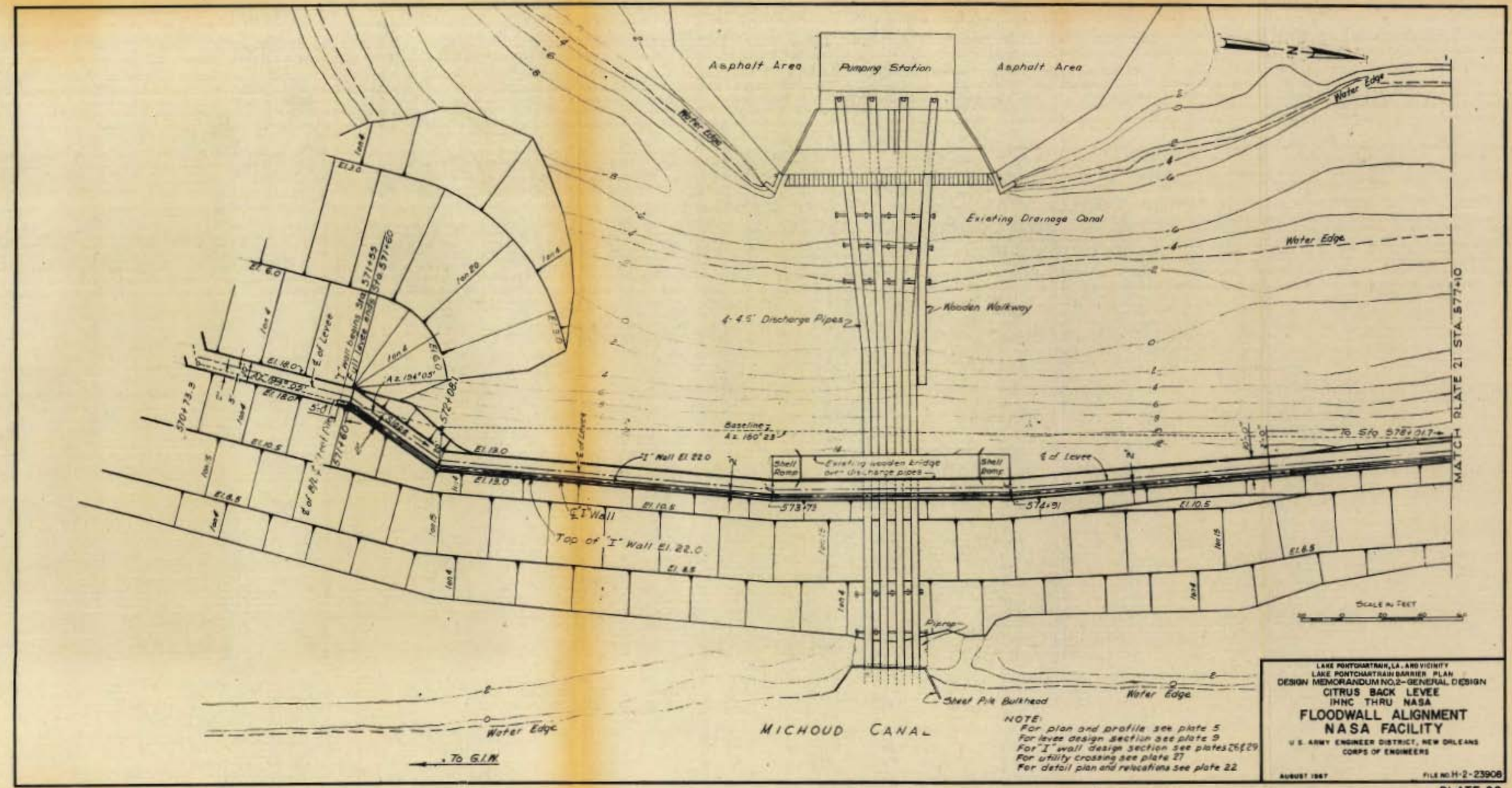

CURVE DATA
Δ = 18°30'
D = 22°28'
R = 255.0'
T = 133.9'
L = 331.6'
E 12.0
E 8.0
Levee enlargement
Guy wire & anchor
6" Transite Water Pipe To Be Relocated
Power & Tel Lines
Berm - slope varies
Sta 0+00 BL
Sta 0+00 Rd
Fill to el 8.5
Guys, Anchors, Tel Cable, & Poles to be relocated
Tel Cable
Asphalt Surface
Concrete Slab
Concrete Slab
Asphalt Surface
15" Water Pipe
Guy wire anchor
Power & Tel Lines
Existing drainage canal
Relocated Drainage Ditch
Fill to el 8.5
Construct temporary ditch during construction of new access road
3-54" Corr metal culv pipes (to be removed after completion of new access road)
3-54" Corr metal culv pipes (to be constructed under new road)
6' New Access Road
Existing road surface & pervious material to be removed within limits of new work
Shoulder
Asphalt Paving
Saturn Dock Road (Existing)
Shoulder
MICHOUD DOCKS
Wharf Slip
N
ELEVATION IN FEET M.S.L.
80' V.C.
100' V.C.
150' V.C.
Sta 0+00 PVC
Sta 0+55 PVT
Sta 1+00 PVC
Sta 1+50 PVT
Sta 3+00 PVC
Sta 4+00 PVT
Sta 4+08.5 PVC
Sta 4+58.5 PVT
Grades are finished roadway grades.
E 12.0
E 7.61
E 14.94
E 12.54
E 9.25
E 4.75
Ground Surface
PROFILE
TYPICAL SECTION THRU ACCESS ROAD
45' Roadway
5' Shoulder
Ditch Varies
1½ Asphalt Concrete Surface Course
Tack Coat
1½ Asphalt Concrete Binder Course
Prime & Tack Coats
12" Sand Shell Base Course
25" Select Material Subgrade
Roadway
4% Slope
Existing Grade
NOTE:
For plan & profile see plate 6
For levee design sections see plate 8
SCALE IN FEET
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
INMC THRU MRGO
ROAD RELOCATION-MICHOUD DOCK
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 19

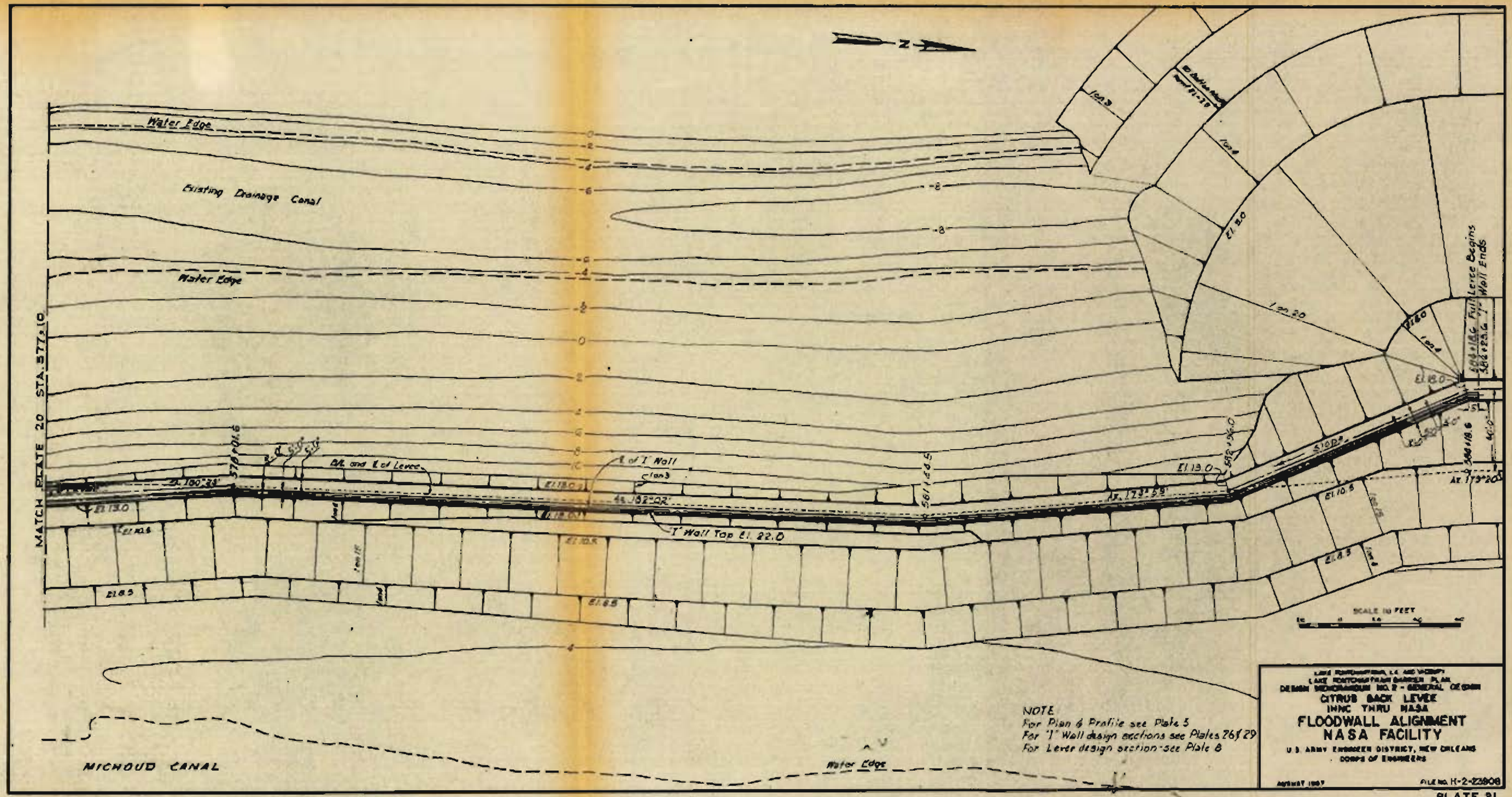


NOTE:
For plan and profile see plate 5
For levee design section see plate 9
For "I" wall design section see plates 26 & 29
For utility crossing see plate 27
For detail plan and relocations see plate 22

LAKE PONTCHARTRAIN, LA., AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
INNC THRU NASA
FLOODWALL ALIGNMENT
NASA FACILITY
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 — FILE NO. H-2-23908

PLATE 20



NOTE
For Plan & Profile see Plate 5
For "I" Wall design sections see Plates 26 & 29
For Levee design section - see Plate 8

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN

CITRUS BACK LEVEE
INNC THRU NASA

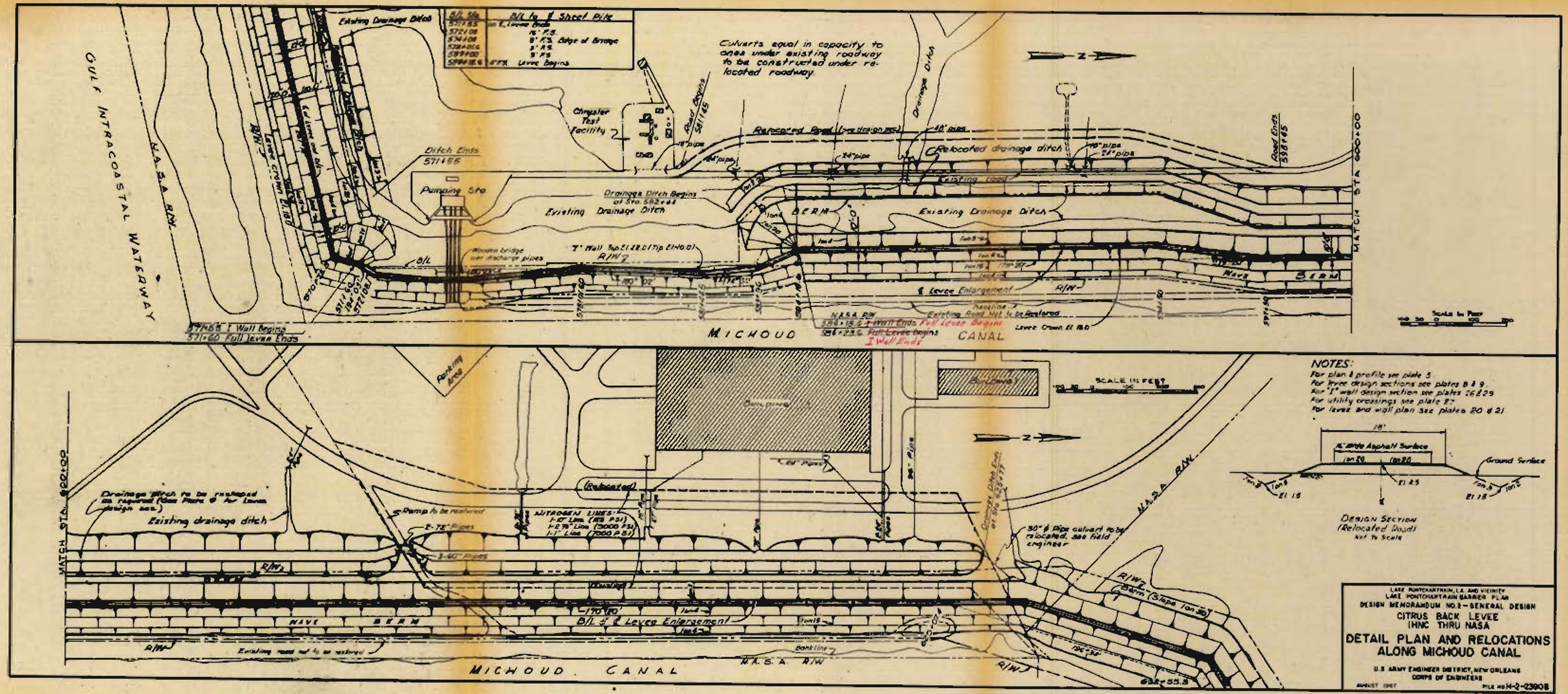
FLOODWALL ALIGNMENT
NASA FACILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967

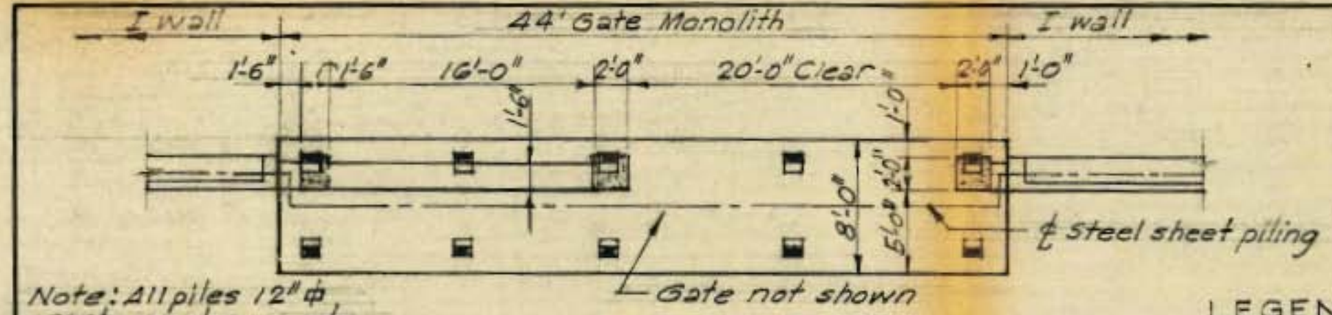
FILE No. H-2-23808

PLATE 21



B/L Sta	B/L to ℄ Sheet Pile
571+55	℄ Levee Ends
572+08	15' P.S.
574+08	8' P.S. Edge of Bridge
578+06.6	5' P.S.
579+92	8' P.S.
584+16.6	8'P.S. Levee Begins

PLATE 22



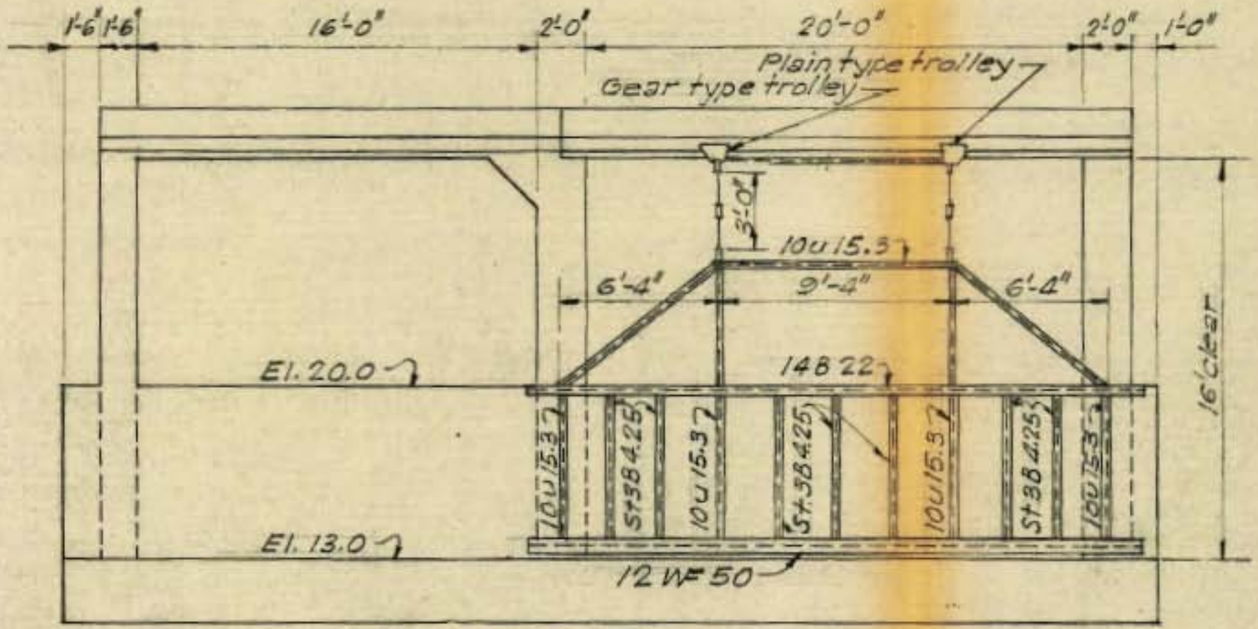
Note: All piles 12" ⌀ prestressed concrete.

PLAN AT ELEVATION 24.0

Scale 1/8" = 1'-0"

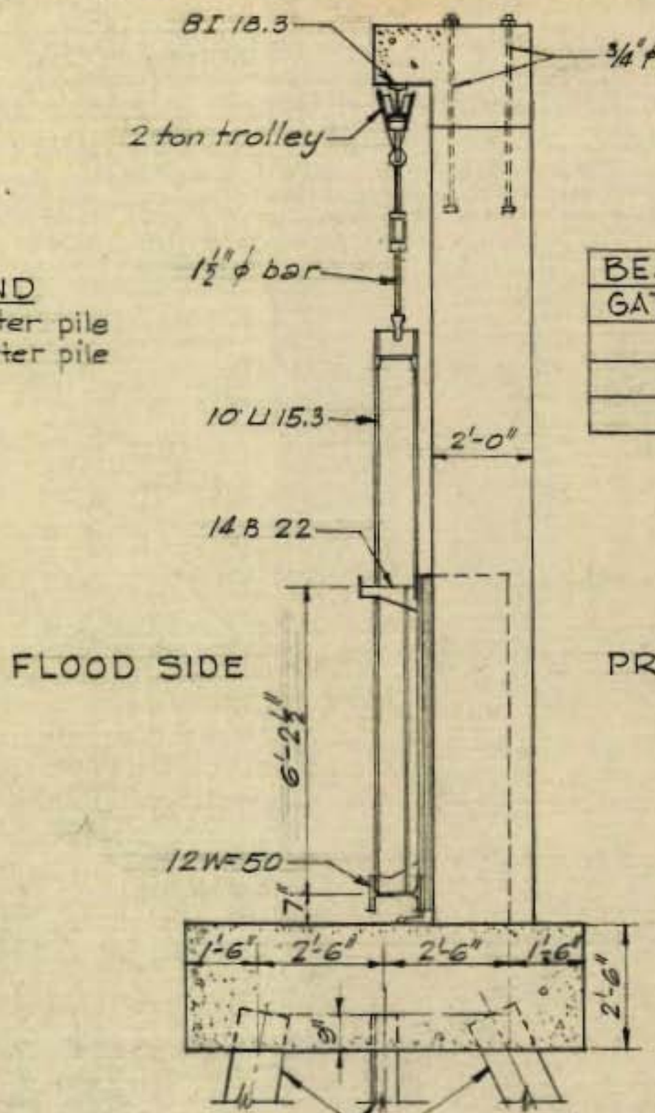
LEGEND

- 2 on 1 Batter pile
- 6 on 1 Batter pile



FLOOD SIDE ELEVATION

Scale 3/16" = 1'-0"



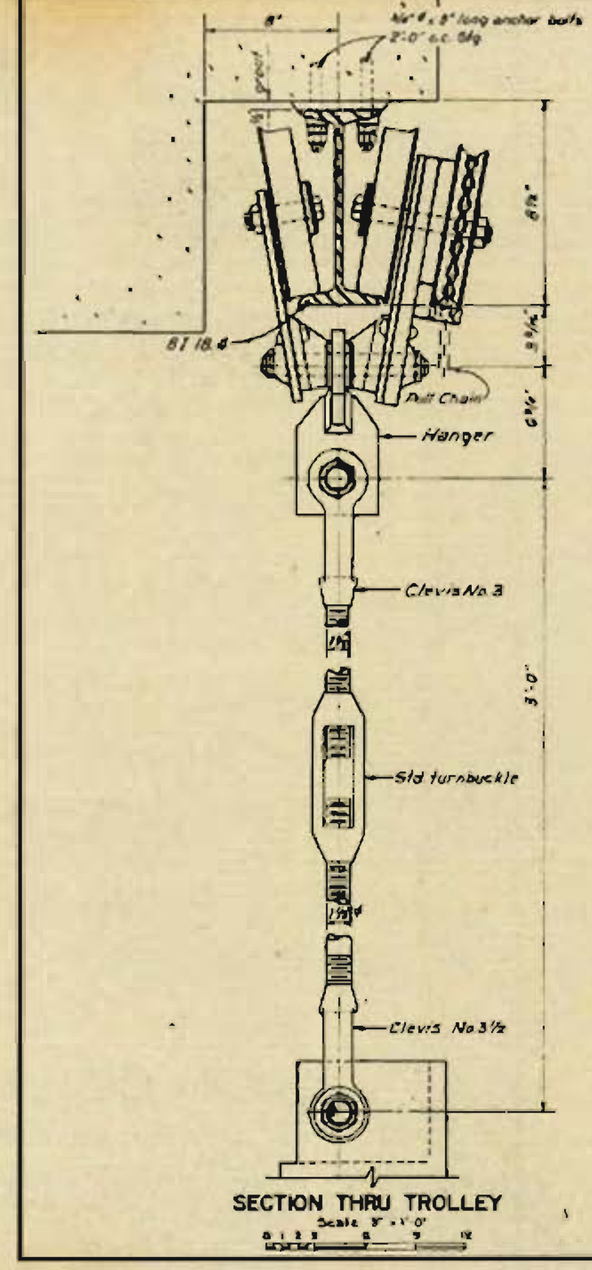
SECTION

Scale 3/8" = 1'-0"

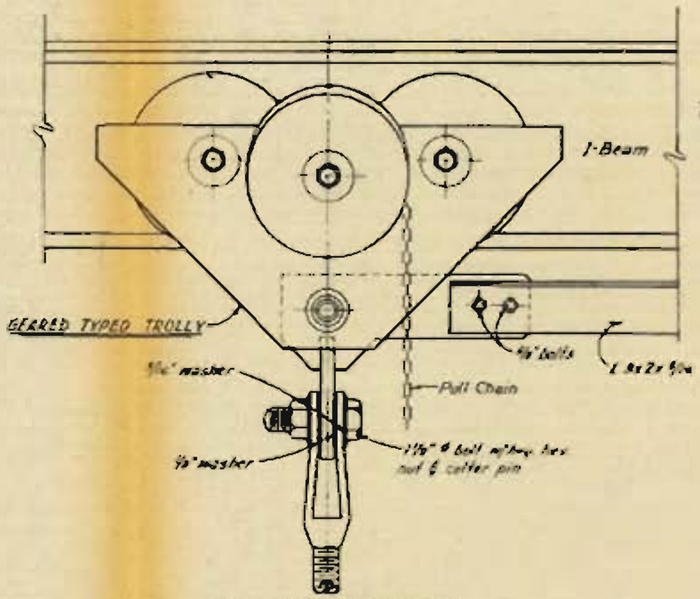
BEARING PILE SCHEDULE	
GATE NUMBER	TIP ELEVATION
1	-49.0
2	-49.0
3	-49.0

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
(HNC THRU NASA
OVERHEAD ROLLER GATE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967 FILE NO. H-2-23908

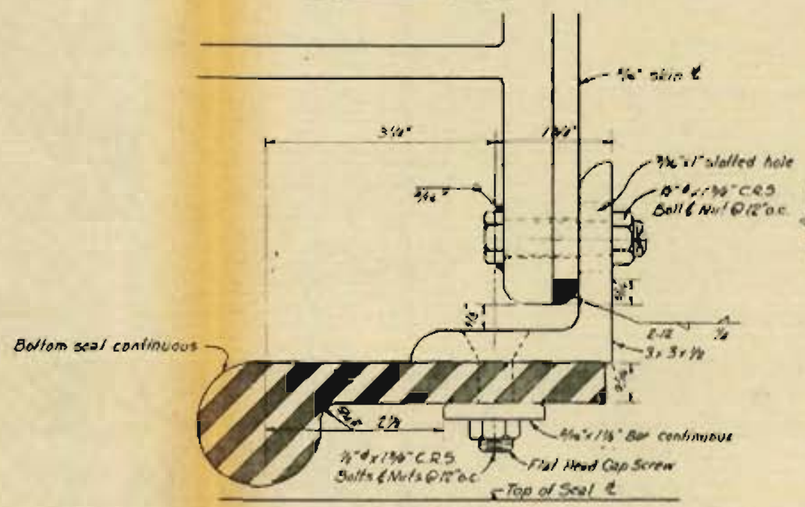
PLATE 23



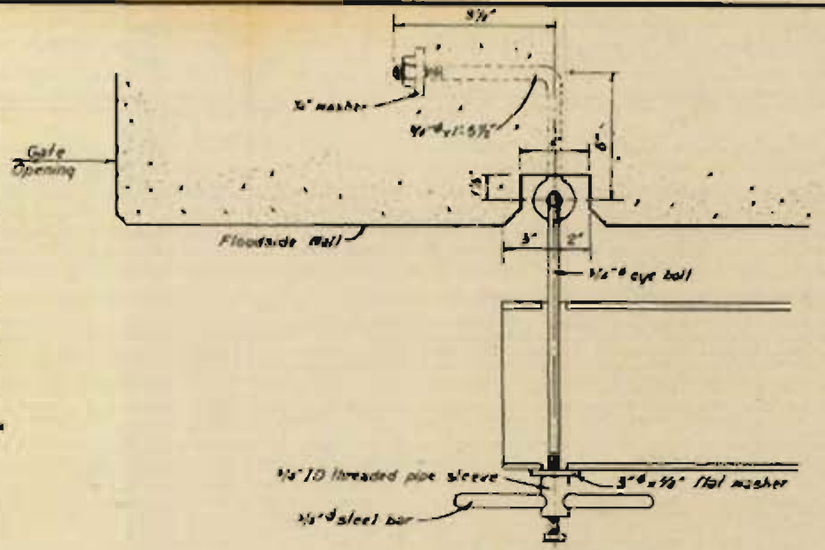
SECTION THRU TROLLEY



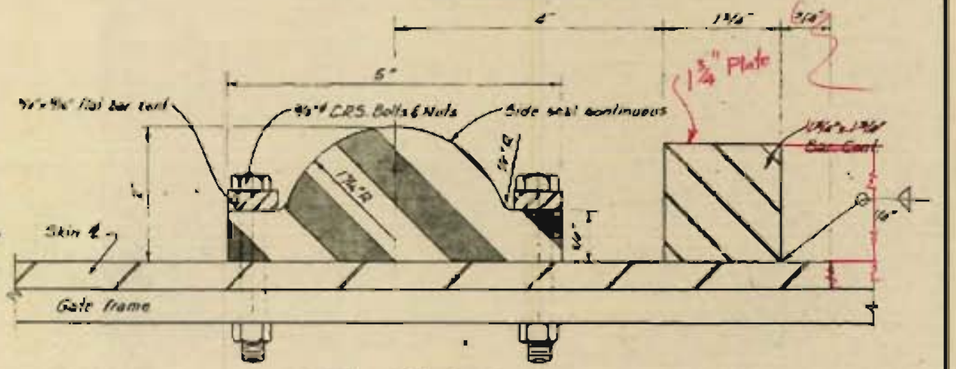
FLOODSIDE ELEVATION



DETAIL BOTTOM SEAL



LOCKING ASSEMBLY
(GATE OPEN)



DETAIL SIDE SEAL

NOTE:
All details full size except where noted.

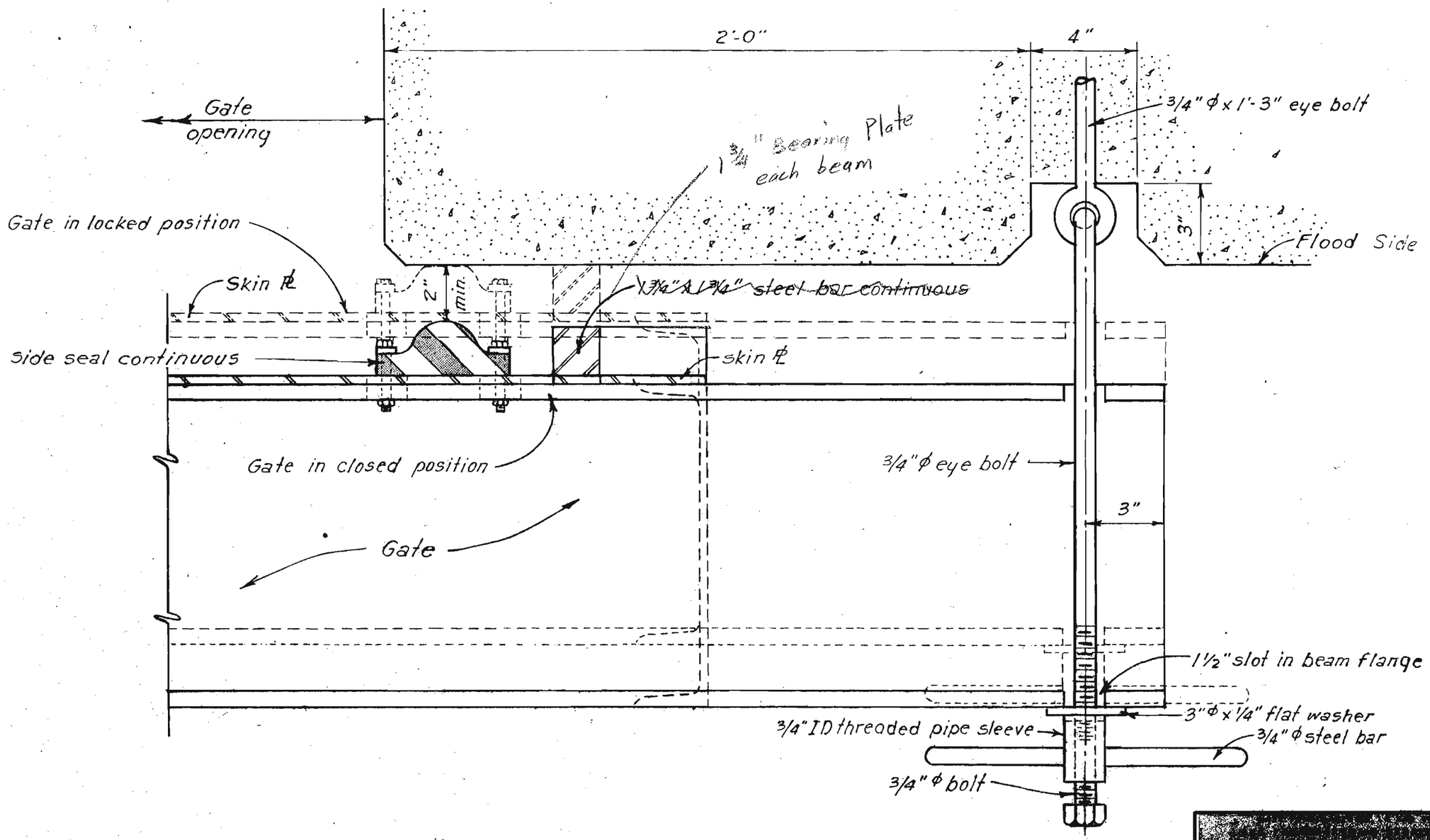
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2- GENERAL DESIGN
CITRUS BACK LEVEE
INNC THRU NASA

GATE DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO H-2-23808

PLATE 24



PART PLAN

Scale 3" = 1'-0"

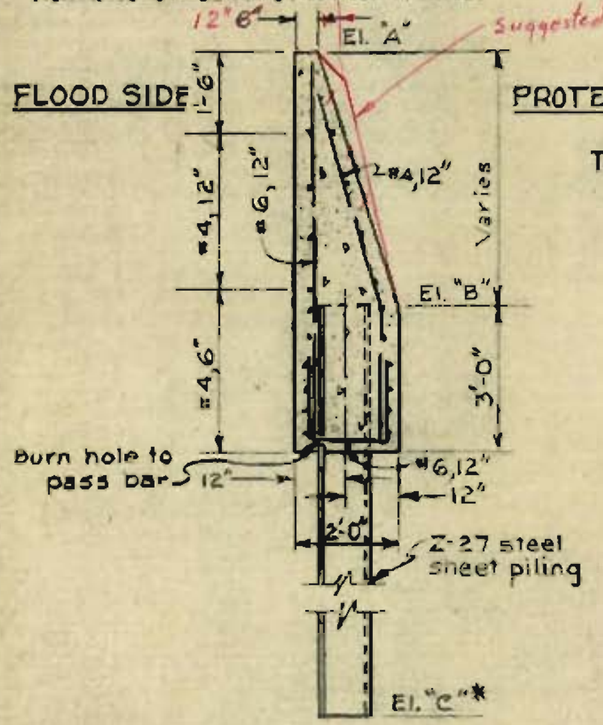
0 1 2 3 6 9 12

GATE IN CLOSED POSITION

430+95

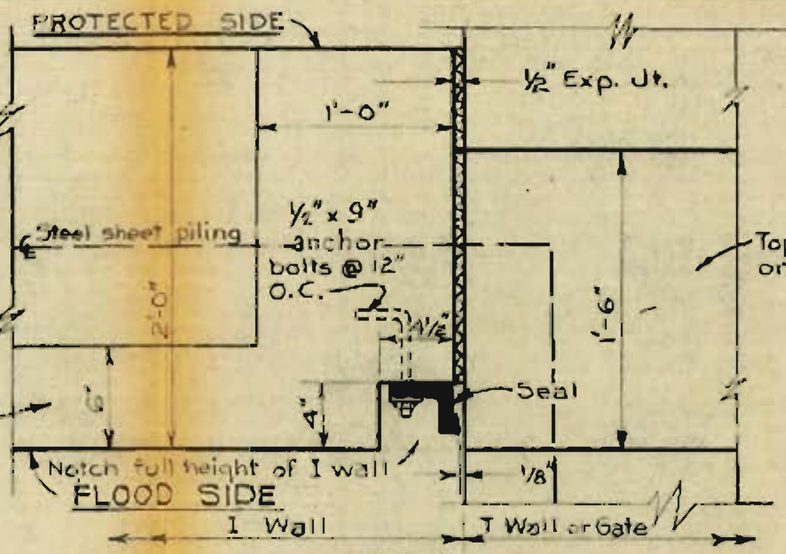
LOCATION	El. "A"	El. "B"	El. "C"*
Sta. 253+35 to 271+55	15.0	10.0	-9.5
Sta. 431+00 to 454+80	20.0	14.0	-10.0
Sta. 571+55 to 584+76	22.0	14.0	-10.0

*Except for "T" wall sta. 255+10 to sta. 255+30 & ramp sta. 256+44 to sta. 256+68, roller gates no. 1, 2, & 3, and transitions from levee to floodwall & floodwall to levee.



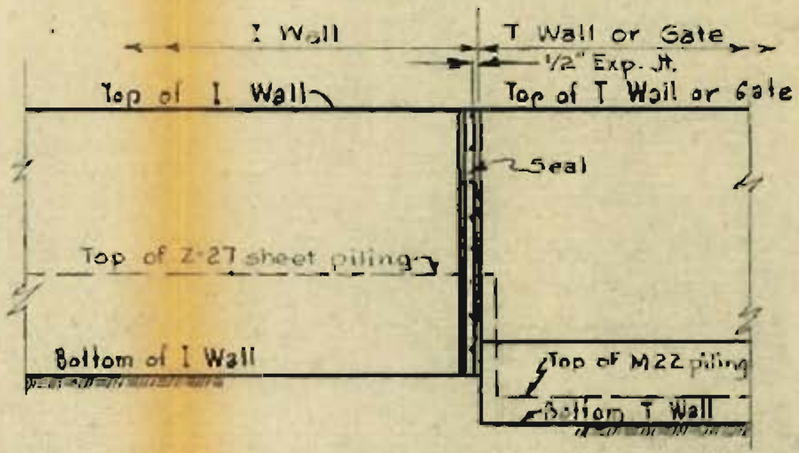
TYPICAL I WALL SECTION

SCALE: 3/8" = 1'-0"



PLAN

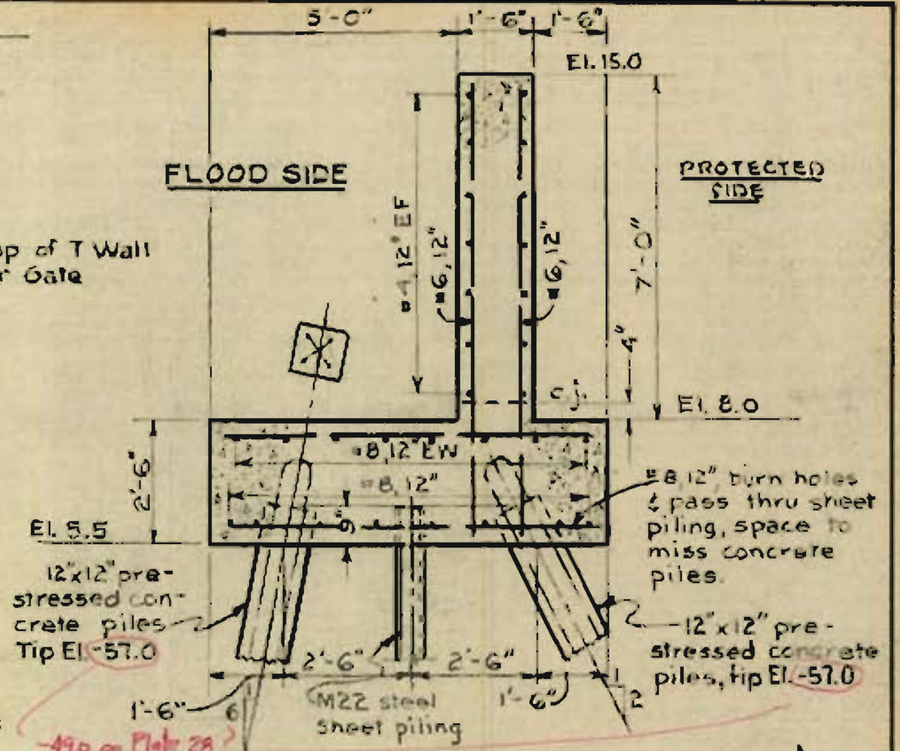
SCALE: 1½" = 1'-0"



ELEVATION

SCALE: ¼" = 1'-0"

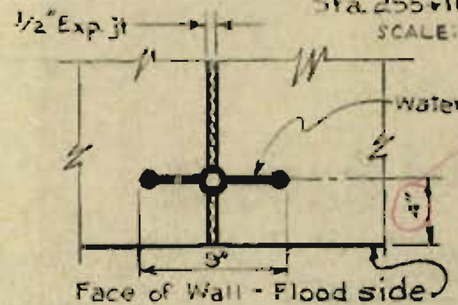
TYPICAL JOINT BETWEEN I WALL & T WALL OR GATE



TYPICAL T WALL SECTION

Sta. 255+10 to 255+90

SCALE: ⅜" = 1'-0"



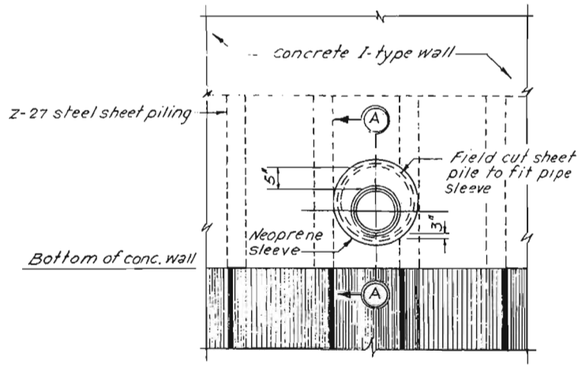
TYPICAL I WALL MONOLITH JOINT

SCALE: 1½" = 1'-0"

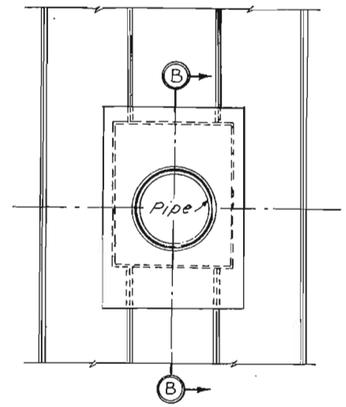
NOTE: For plan & profile see plates 2, 3, 4, & 5.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
FLOODWALL DETAILS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 26

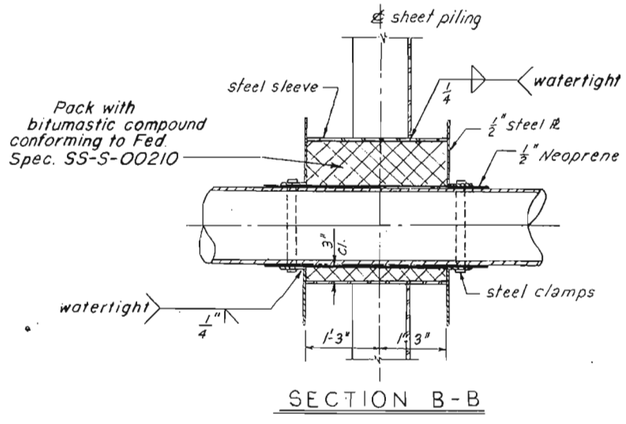


ELEVATION



ELEVATION

SECTION A-A



SECTION B-B

DETAILS OF WATER PIPE LINES, OIL LINES AND CABLE CROSSINGS

Scale: $\frac{3}{4}$" = 1'-0"

TYPICAL DETAIL OF 30"ø THRU 90"ø PIPE LINE CROSSINGS

Scale: $\frac{3}{4}$" = 1'-0"

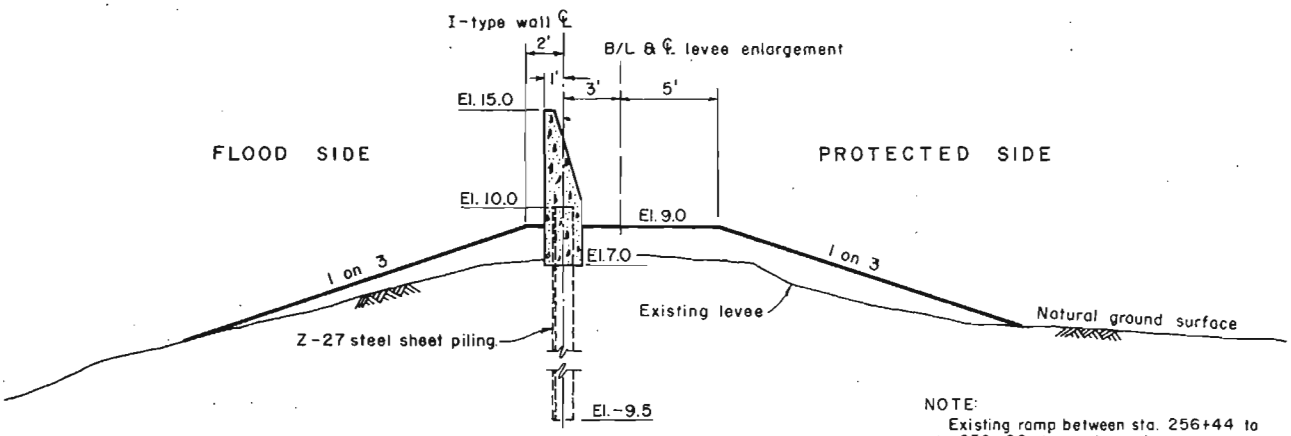
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

UTILITY CROSSINGS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

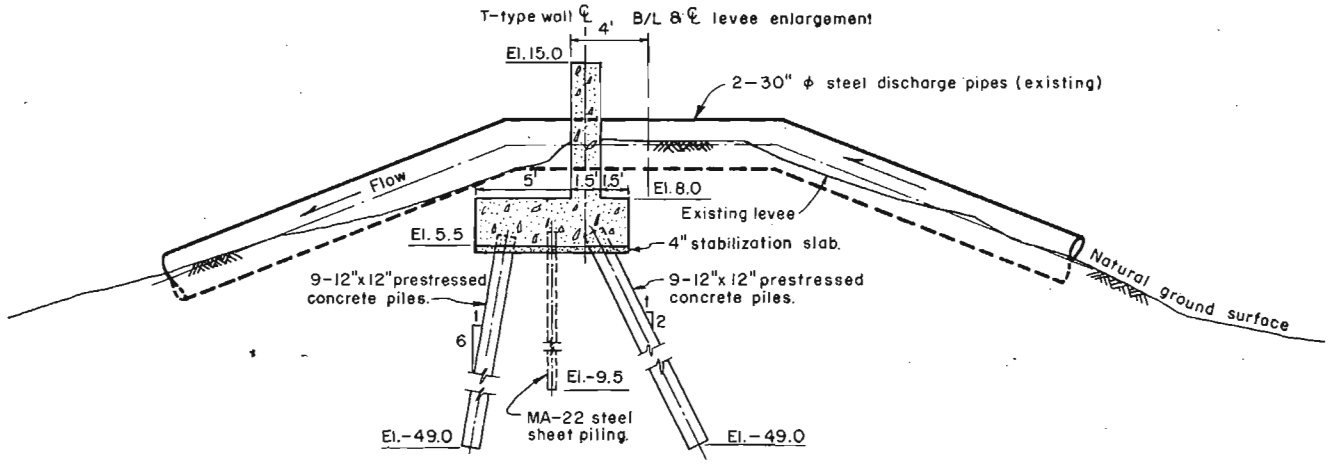
AUGUST 1967 FILE NO. H-2-23908

PLATE 27

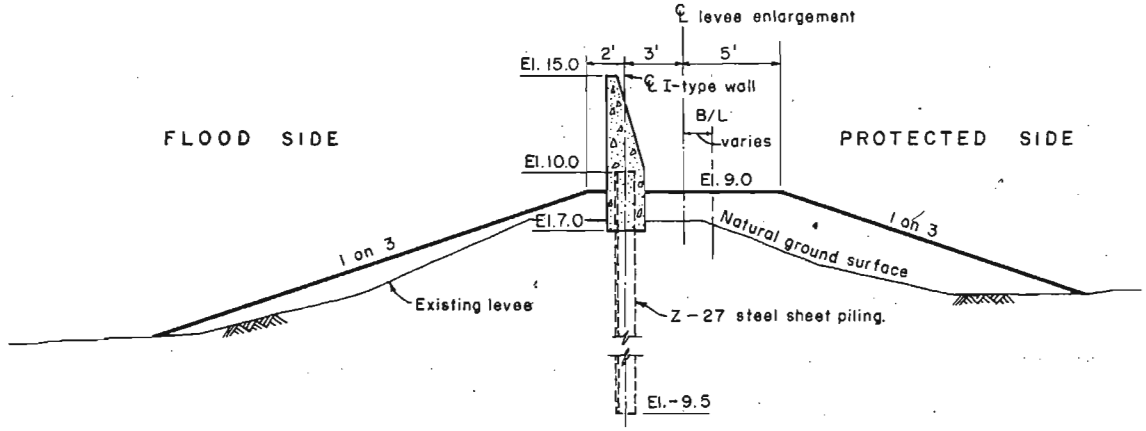


NOTE:
Existing ramp between sta. 256+44 to sta. 256+68. No work required.

STA. 253+35 TO STA. 255+10
STA. 255+90 TO STA. 256+44
STA. 256+68 TO STA. 266+00



STA. 255+10 TO STA. 255+90



STA. 266+00 TO STA. 271+55

NOTE:
For foreshore protection see detail "A" on plate 6.

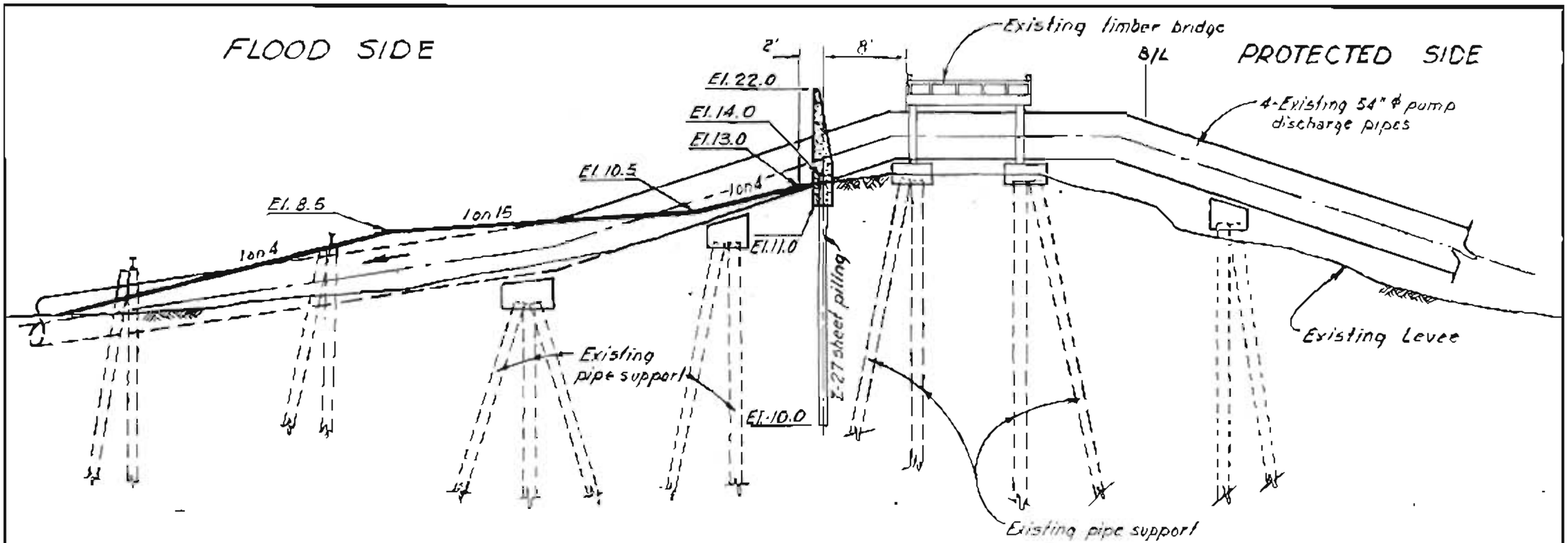
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

DESIGN SECTIONS

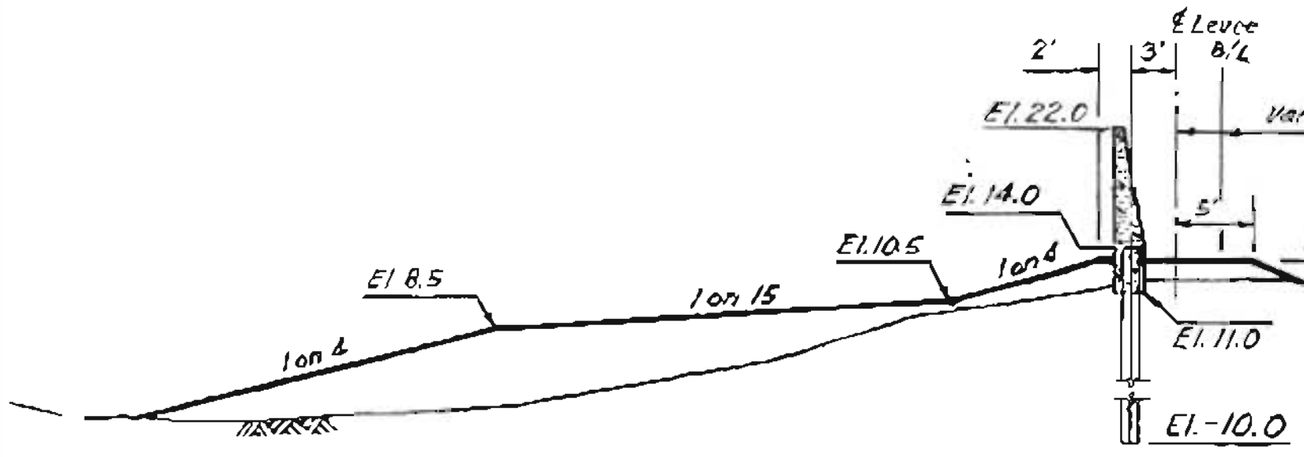
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-23908

PLATE 28



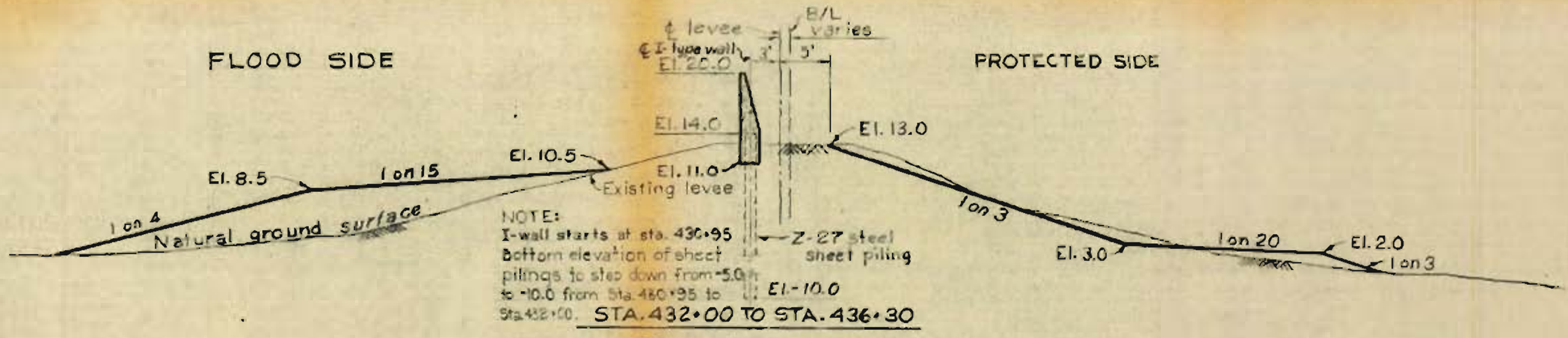
Sta. 574 + 17.08 to Sta. 574 + 35.0



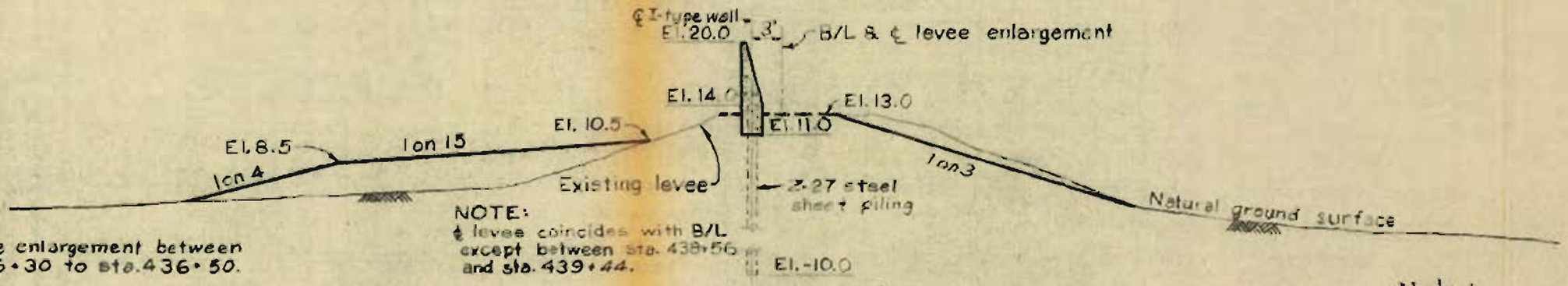
NOTE:
Bottom elevation of sheet piling to step down from -5.0 to -10.0 from Sta. 571 + 55 to 571 + 60.
Bottom elevation of sheet piling to step up from -10.0 to -5.0 from Sta. 584 + 18.6 to 584 + 23.6
For foreshore protection, see Detail "A" on Plate 6.

Sta. 571 + 55 to Sta. 574 + 17.08
Sta. 574 + 35.0 to Sta. 584 + 23.6

DESIGN SECTIONS



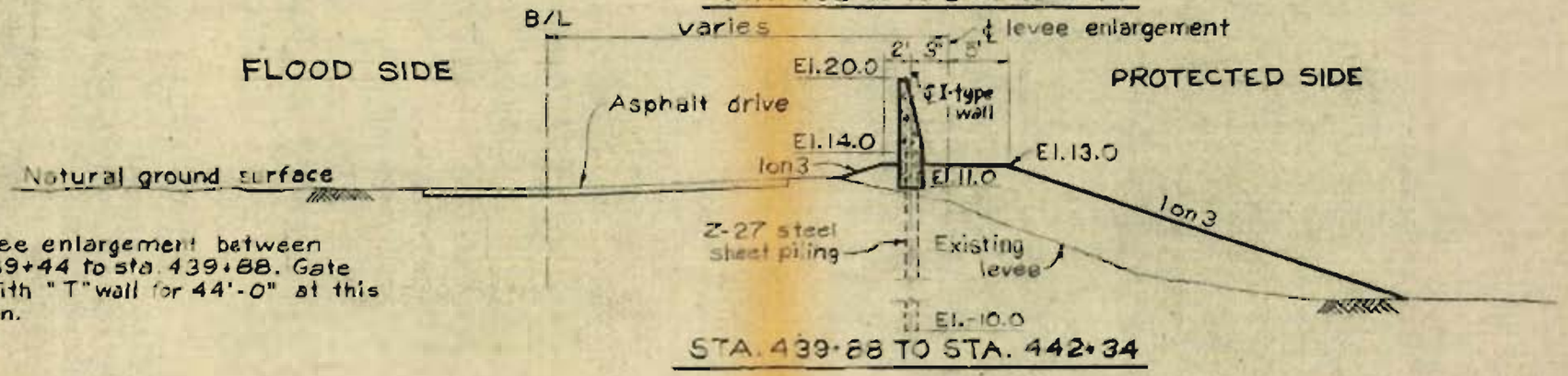
STA. 432+00 TO STA. 436+30



No levee enlargement between sta. 436+30 to sta. 436+50.

STA. 436+50 TO STA. 439+44

Note :
For foreshore protection see Detail "A" on Plate 6

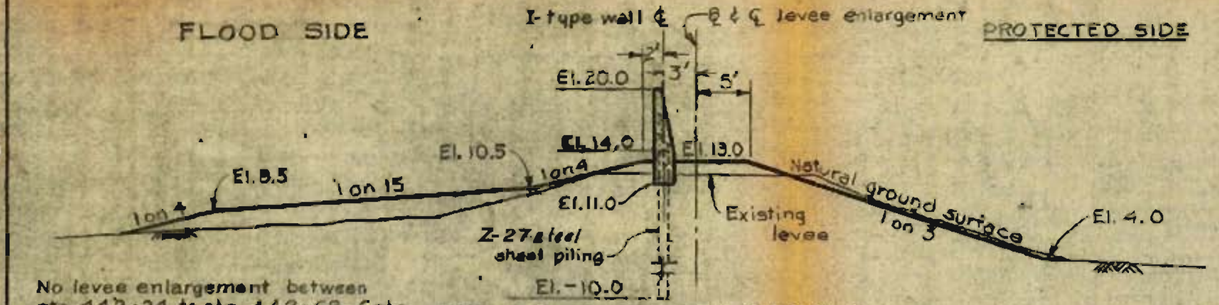


No levee enlargement between sta. 439+44 to sta. 439+88. Gate no. 1 with "T" wall for 44'-0" at this location.

STA. 439+88 TO STA. 442+34

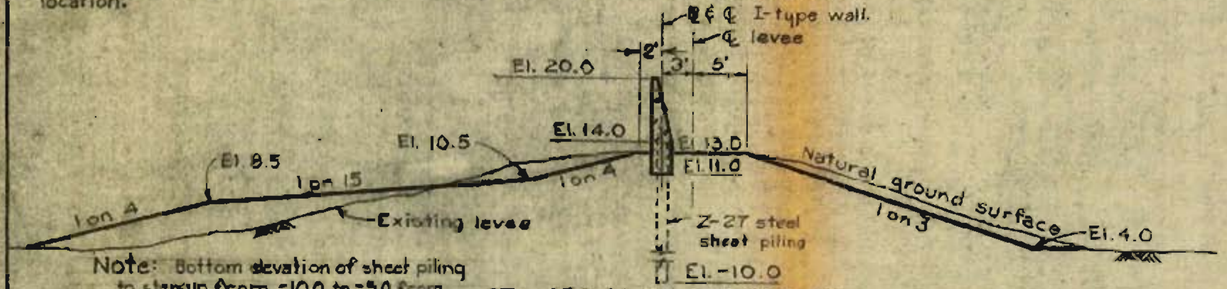
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
DESIGN SECTIONS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 30



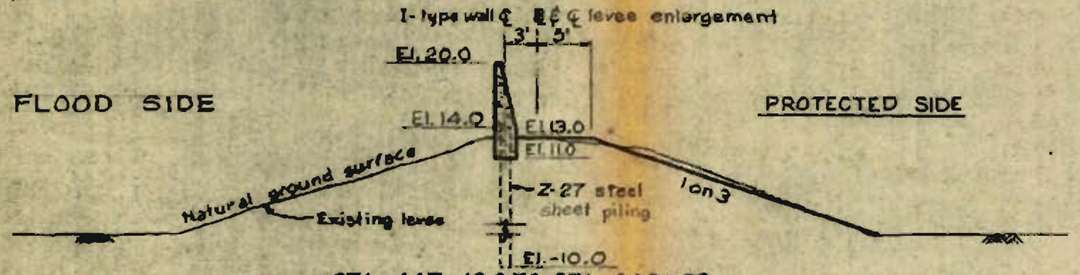
No levee enlargement between sta. 442+34 to sta. 442+68. Gate no. 2 with "T" wall located at this location.

STA. 442+68 TO STA. 447+01.9
STA. 449+38 TO STA. 452+35

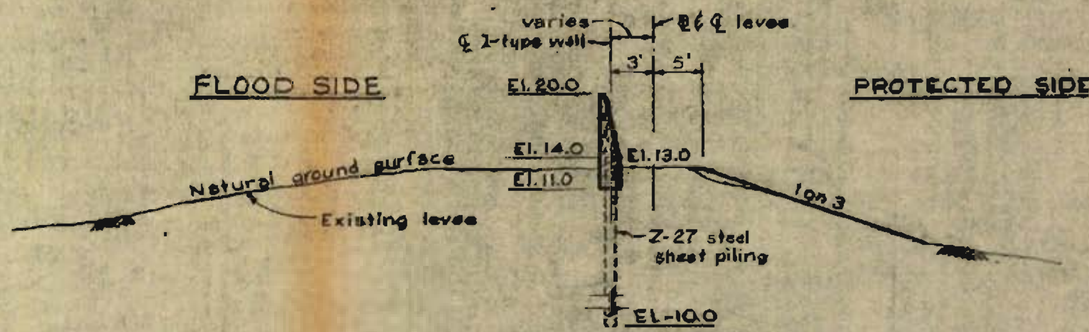


Note: Bottom elevation of sheet piling to step up from -10.0 to -5.0 from Sta. 454+62 to 454+80.

STA. 453+90 TO STA. 454+80



STA. 447+42.9 TO STA. 449+38



STA. 452+35 TO STA. 453+90

Note
For foreshore protection, see Detail "A" on Plate 6.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2-GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
DESIGN SECTIONS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 31

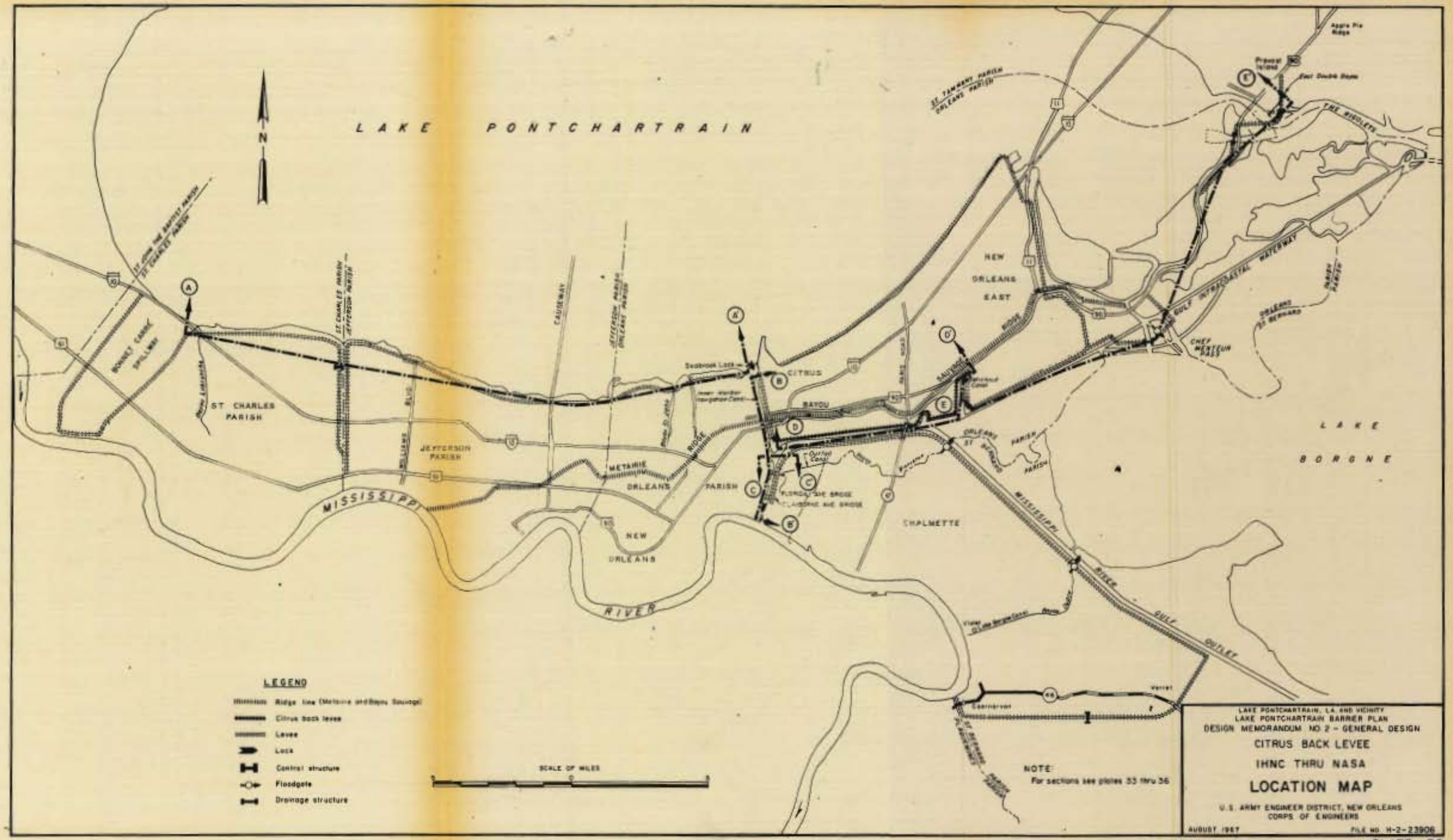
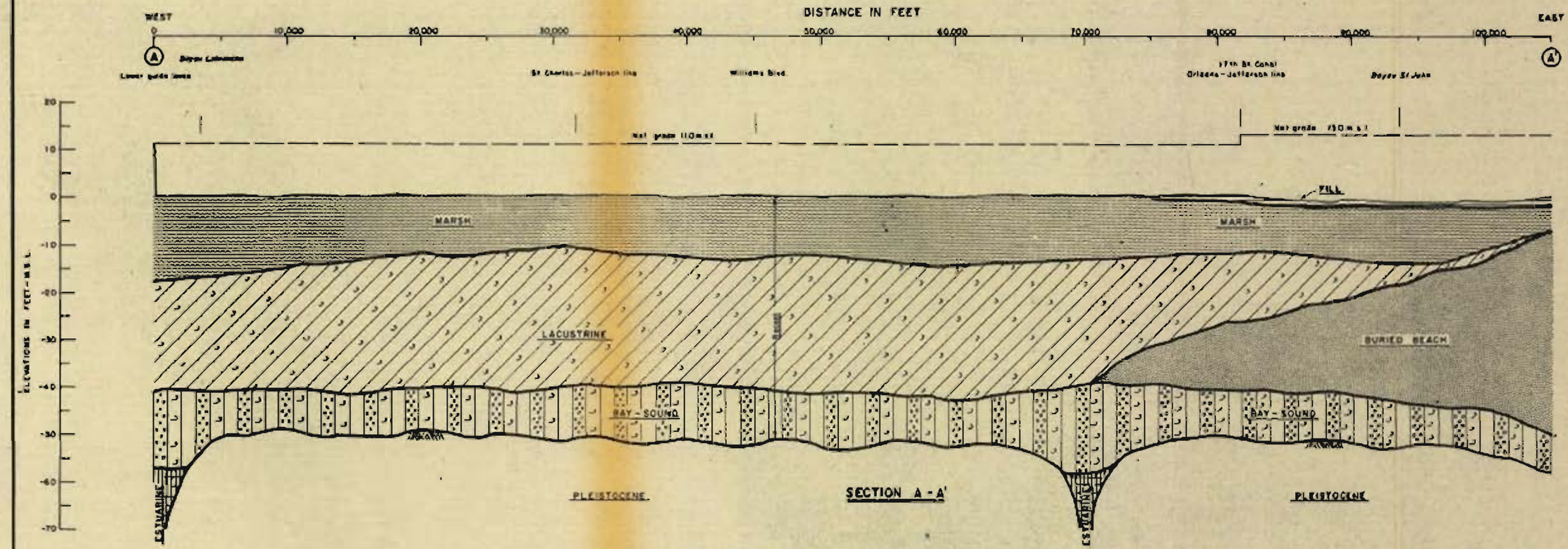

LAKE PONTCHARTRAIN
N
ST CHARLES PARISH
JEFFERSON PARISH
METAIRIE RIDGE
NEW ORLEANS
CITRUS
BAYOU
CHALMETTE
NEW ORLEANS EAST
LAKE BORGNE
MISSISSIPPI RIVER
GULF OUTLET
GULF INTRACOASTAL WATERWAY
THE RIGOLETS
CAUSEWAY
BONNET CARRE SPILLWAY
Seabrook Lock
Florida Ave Bridge
Claiborne Ave Bridge
Inner Harbor Navigation Canal
Orleans Parish
St Bernard Parish
St Tammany Parish
Jefferson Parish
St John the Baptist Parish
St Charles Parish
Agate Pie Ridge
Proctor Island
Fort Double Gate
Chef Menteur
Irish Bayou
Verret
Caernarvon
LEGEND
Ridge line (Metairie and Bayou Sauvage)
Citrus back levee
Levee
Lock
Control structure
Floodgate
Drainage structure
SCALE OF MILES
NOTE:
For sections see plates 33 thru 36
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LOCATION MAP
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23906

PLATE 32



SECTION A - A'

L E G E N D

- FILL
- MARSH (very soft clays with organic matter and peat)
- LACUSTRINE (very soft clays with shell fragments)
- BURIED BEACH (sands with shell and shell fragments)
- BAY-SOUND (silts, silty sands and clays with shell fragments)
- ESTUARINE (sands, clays and silts with shell fragments)
- PLEISTOCENE HORIZON

NOTE
For location of section A-A' see plate 32

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

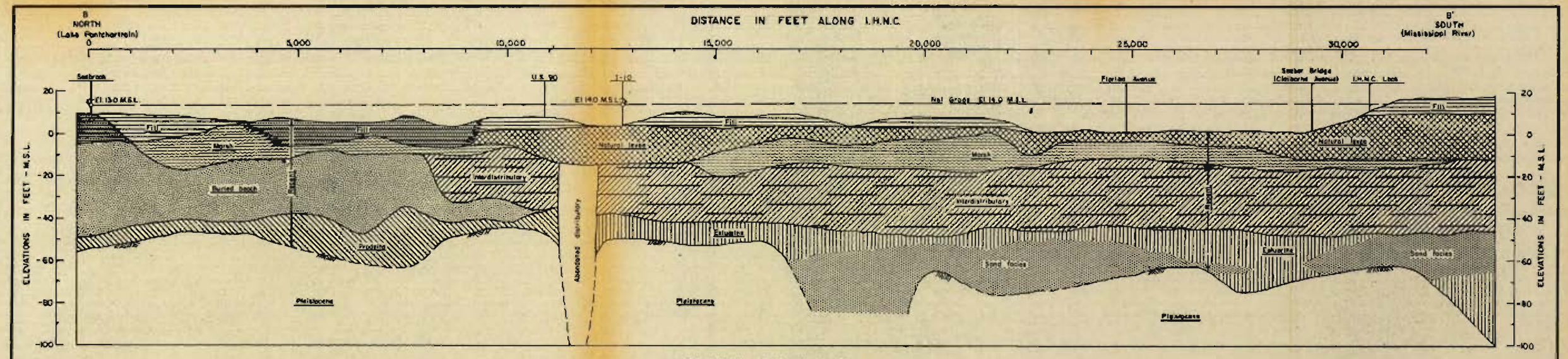
GENERALIZED GEOLOGIC PROFILE

BONNET CARRÉ TO IHNC
SECTION A-A'

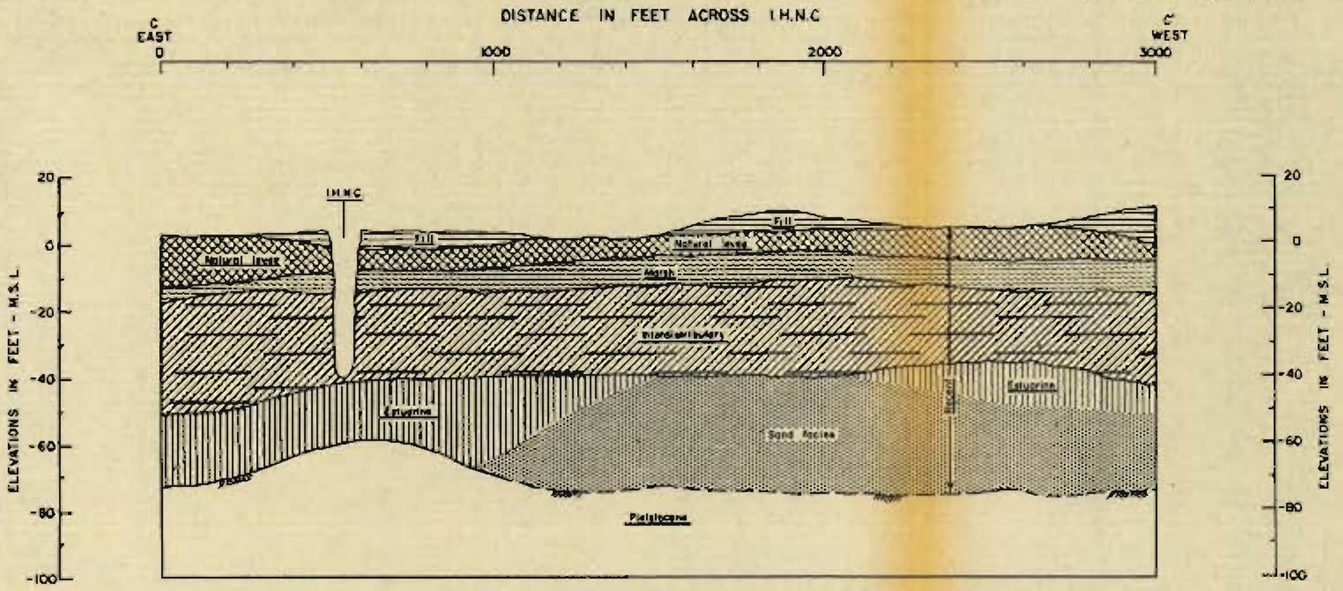
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. N-2-23908

PLATE 33



GENERALIZED SECTION B-B'
ALONG WEST SIDE I.H.N.C.



GENERALIZED SECTION C-C'
ACROSS I.H.N.C. (VICINITY FLORIDA AVENUE)

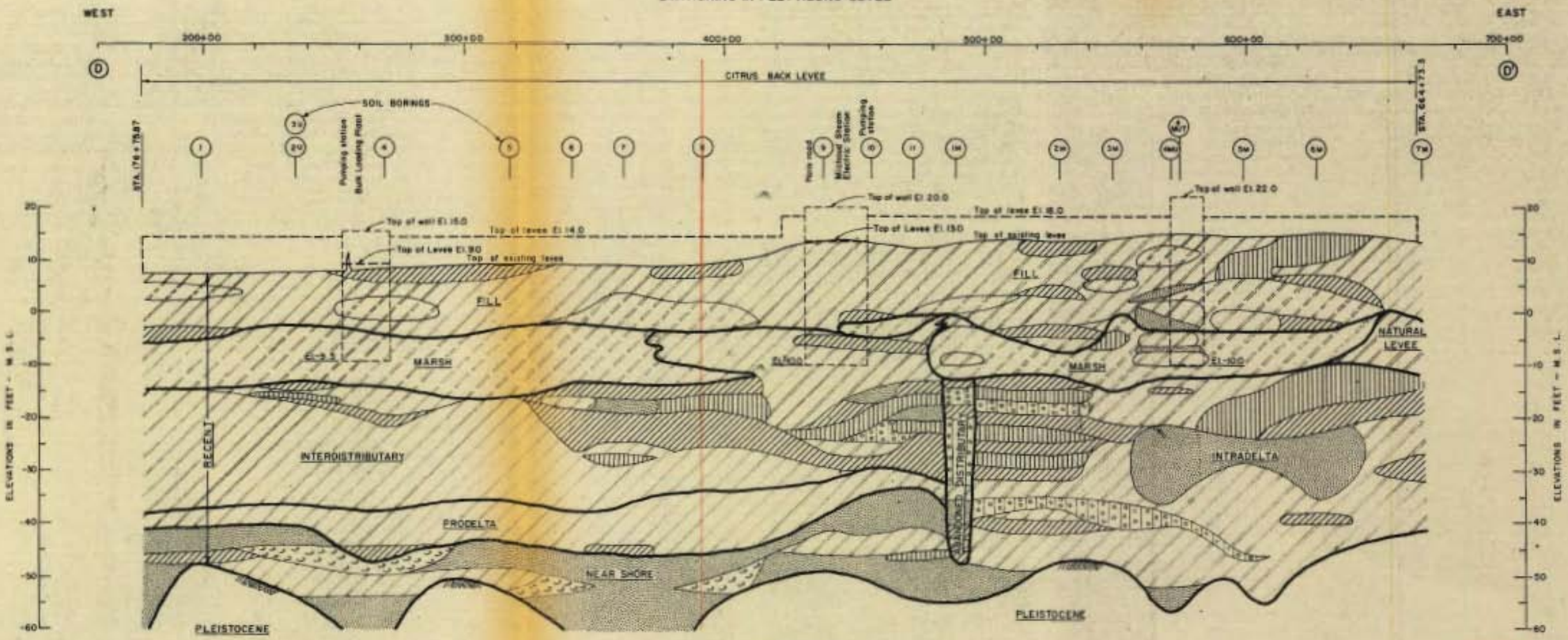
LEGEND

- Fill
- Natural levee (soft to stiff clays w/lenses and layers silt and sand/roots)
- Marsh (very soft organic clays w/peat)
- Interdistributary (very soft to soft clays w/lenses and layers of silt and sand)
- Abandoned distributary (silt and silty sand w/clay layers)
- Estuarine (soft to medium clays and fine sand w/lenses and layers silt and sand and shell fragments)
- Buried beach (fine sand w/shell and fragments and shells)
- Prodelta (medium to stiff clays)
- Pleistocene horizon

NOTE:
For location of sections B-B' and C-C'
see plate 32

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
GENERALIZED GEOLOGIC SECTIONS
LAKE PONTCHARTRAIN TO MISSISSIPPI RIVER
SECTIONS B-B' AND C-C'
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. M-2-23908

PLATE 34



SECTION D-D'

LEGEND

CH - Fat clay	MARSH - very soft clays with organic matter and peat
CHO - Fat clay with organic matter	NATURAL LEVEE - soft to stiff clays with lenses and layers of silt
CL - Lean clay	ABANDONED DISTRIBUTARY - silts and silty sands with lenses and layers of clay
ML - Silt	INTERDISTRIBUTARY - very soft to soft clays with lenses and layers of silts and sands
SM - Silty sand	INTRADELTA - soft alternating clays and silts with layers silty sands and sands
SP - Fine sand	PRODELTA - medium to stiff clays
SI - Shells	NEAR SHORE - sands with shell and shell fragments with lenses and layers of clay
Pleistocene Horizon	

GENERAL NOTES

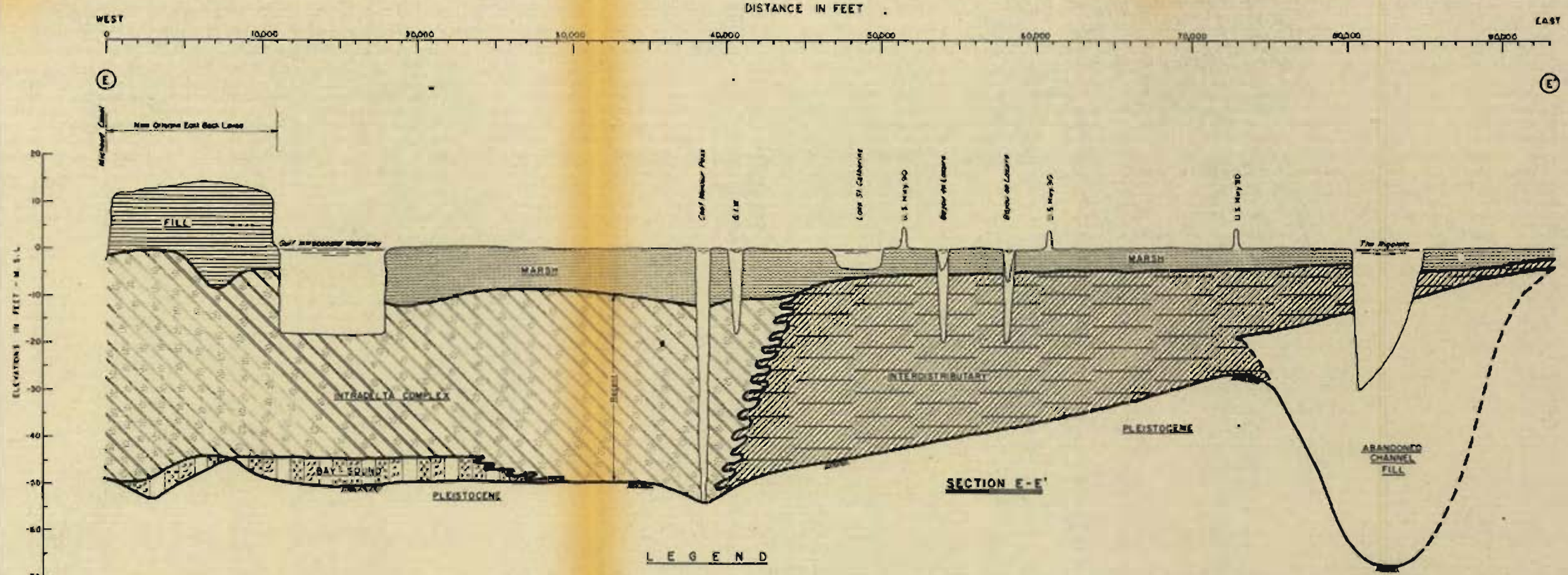
For location of Section D-D' see plate 32
For general type borings see plates 2-5
For undisturbed borings see plates 54-57
For soil boring legend see plate A

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

GENERALIZED SOIL AND GEOLOGIC PROFILE

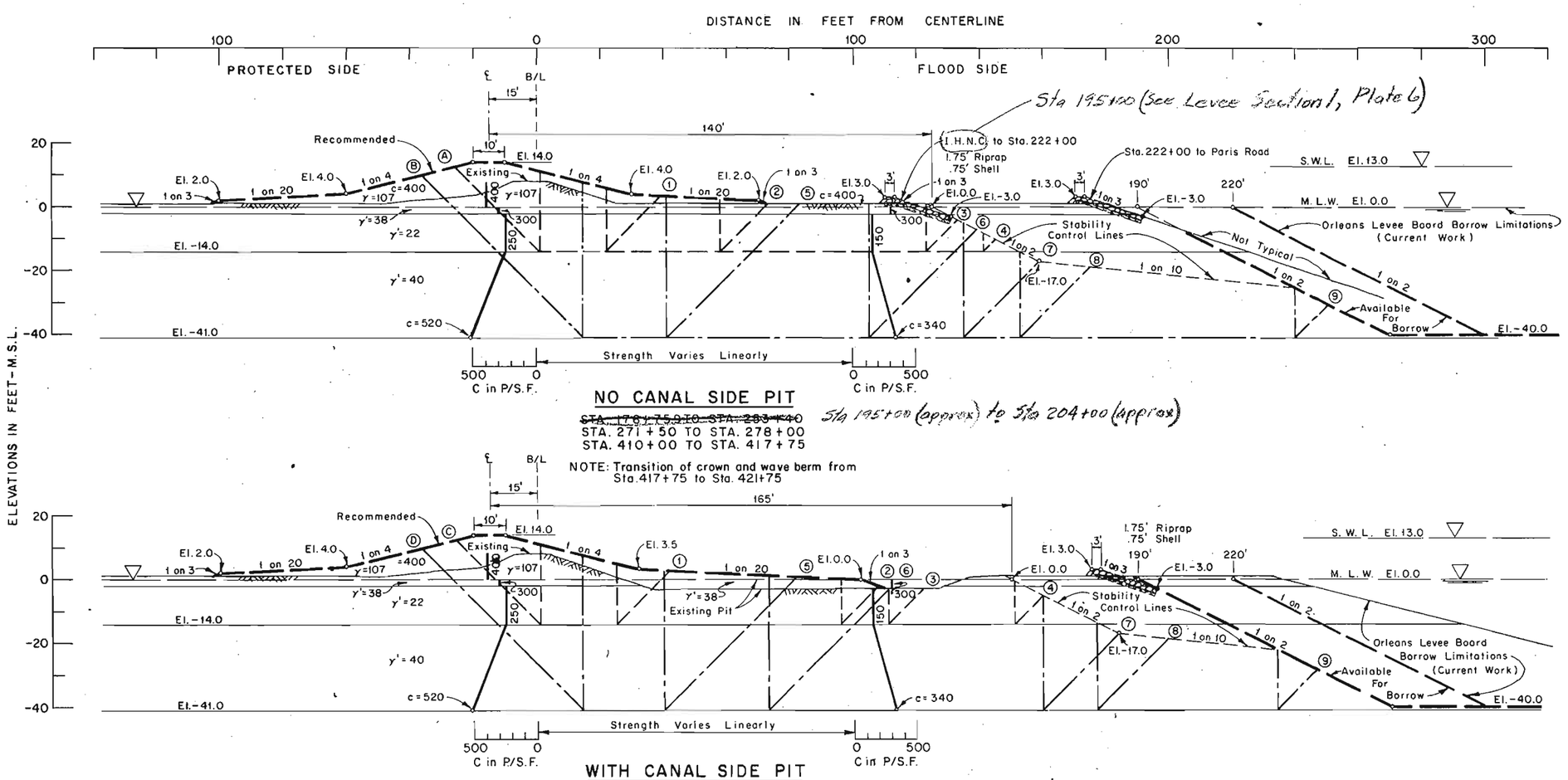
IHNC TO MICHOUD CANAL
SECTION D-D'
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 35



NOTE
For location of section E-E, see plate 32

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
GENERALIZED GEOLOGIC PROFILE
MICHOUD CANAL TO THE RIGOLETS
SECTION E-E'
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
CNO 20 M-2-23808



NO CANAL SIDE PIT

~~STA. 176+75.0 TO STA. 283+40~~ Sta 195+00 (approx) to Sta 204+00 (approx)
STA. 271+50 TO STA. 278+00
STA. 410+00 TO STA. 417+75

NOTE: Transition of crown and wave berm from Sta. 417+75 to Sta. 421+75

WITH CANAL SIDE PIT

STA. 279+00 TO STA. 409+00

STABILITY CALCULATIONS

LEVEE FEATURE		SLIP SURFACE NUMBER	SLIP SURFACE ELEV.	DRIVING $+\bar{D}_A$	DRIVING $-\bar{D}_P$	$\Sigma\bar{D}$	RESISTING $+R_A$	RESISTING $+R_B$	RESISTING $+R_P$	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma\bar{D}$
I. H. N. CANAL EAST LEVEE TO PARIS ROAD	WITHOUT F.S. PIT	A 1	-14.0	32,615	10,202	22,413	16,800	4,683	9,009	30,492	1.36
		2			6,116	26,499		11,713	6,104	34,617	1.31
		3			1,977	30,638		22,500	3,000	42,300	1.38
		4			286	32,329		25,200	1,200	43,200	1.34
		B 5	-41.0	85,009	33,867	51,142	34,990	11,741	21,496	68,227	1.33
		6			26,276	58,733		35,243	15,330	85,563	1.46
		7			15,997	69,012		45,443	11,760	92,193	1.34
		8			11,477	73,532		51,427	10,976	97,393	1.32
		9			3,296	81,713		81,143	5,243	121,376	1.48
	WITH F.S. PIT	C 1	-14.0	32,615	8,997	23,618	16,800	5,328	8,496	30,624	1.30
		2			3,179	29,436		17,778	3,600	38,178	1.30
		3			1,911	30,704		20,028	3,300	40,128	1.31
		4			1,434	31,181		26,028	2,700	45,528	1.46
		D 5	-41.0	85,009	35,614	49,395	34,990	11,321	21,499	67,810	1.37
		6			28,048	56,961		24,233	16,417	75,640	1.33
		7			15,997	69,012		53,943	11,760	100,693	1.46
		8			11,693	73,316		59,553	11,025	105,568	1.44
		9			4,760	80,249		79,103	6,186	120,278	1.50

GENERAL NOTES

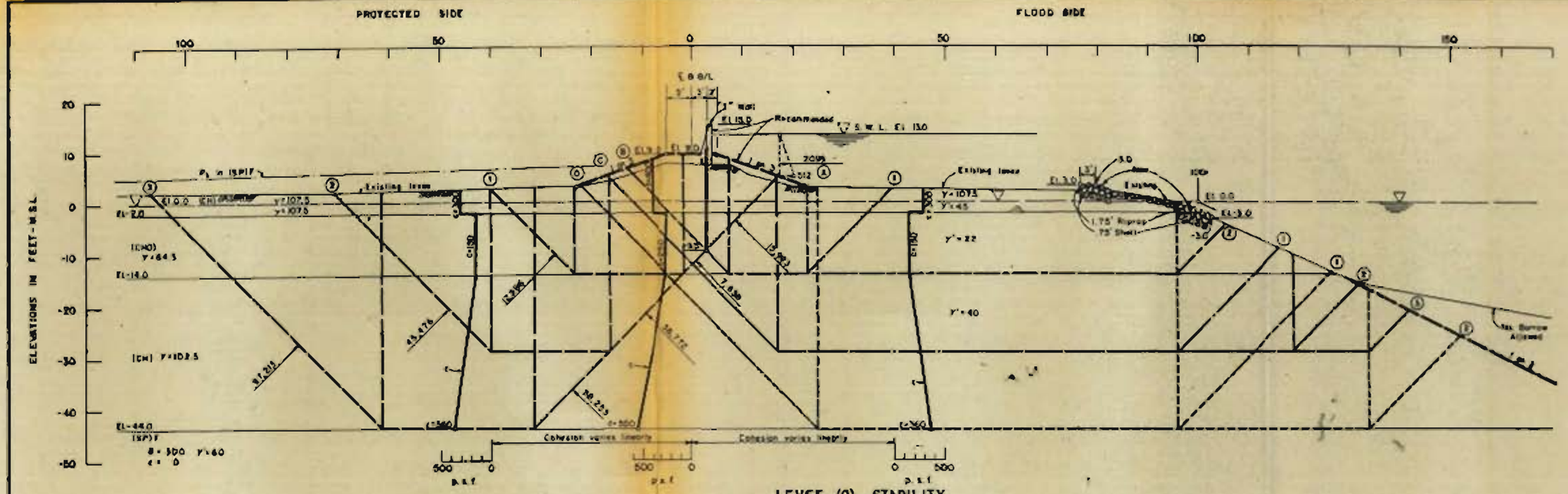
(Q) - Unconsolidated-Undrained shear strength in lbs. per sq. ft.
(γ) - Unit weight of soil water system in pounds per cu. ft.
(γ') - Submerged unit weight of soil in pounds per cu. ft.
(ϕ) - Angle of internal friction in degrees.
$\bar{D}$ - Horizontal driving force in pounds.
R Horizontal resisting force in pounds.
F.S. - Factor of safety with respect to (Q) shear strength.
γ_ω - Unit weight of water in pounds per cu. ft.
MU - 5" diameter undisturbed soil boring.
S.W.L. - Still Water Level for project hurricane.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

LEVEE (Q) STABILITY

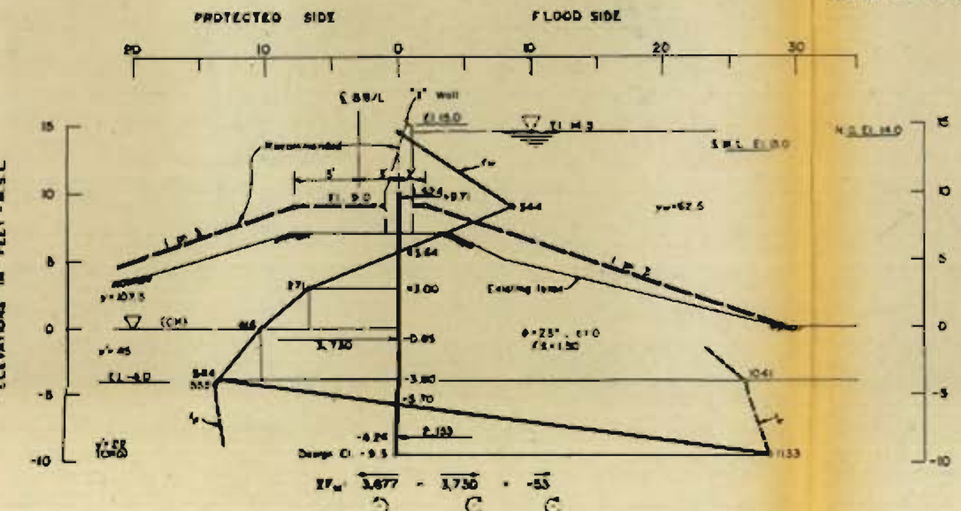
IHNC TO PARIS ROAD
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 37



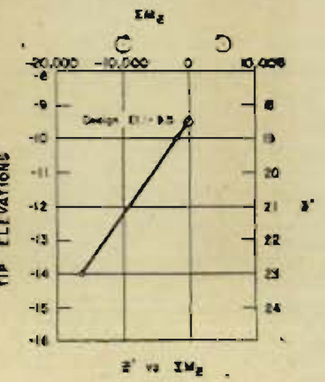
LEVEE (O) STABILITY

(STA. 253+35 to 255+10 & 255+90 to 271+55)



WALL (S) STABILITY

(STA. 253+35 to 255+10 & 256+90 to 271+55)



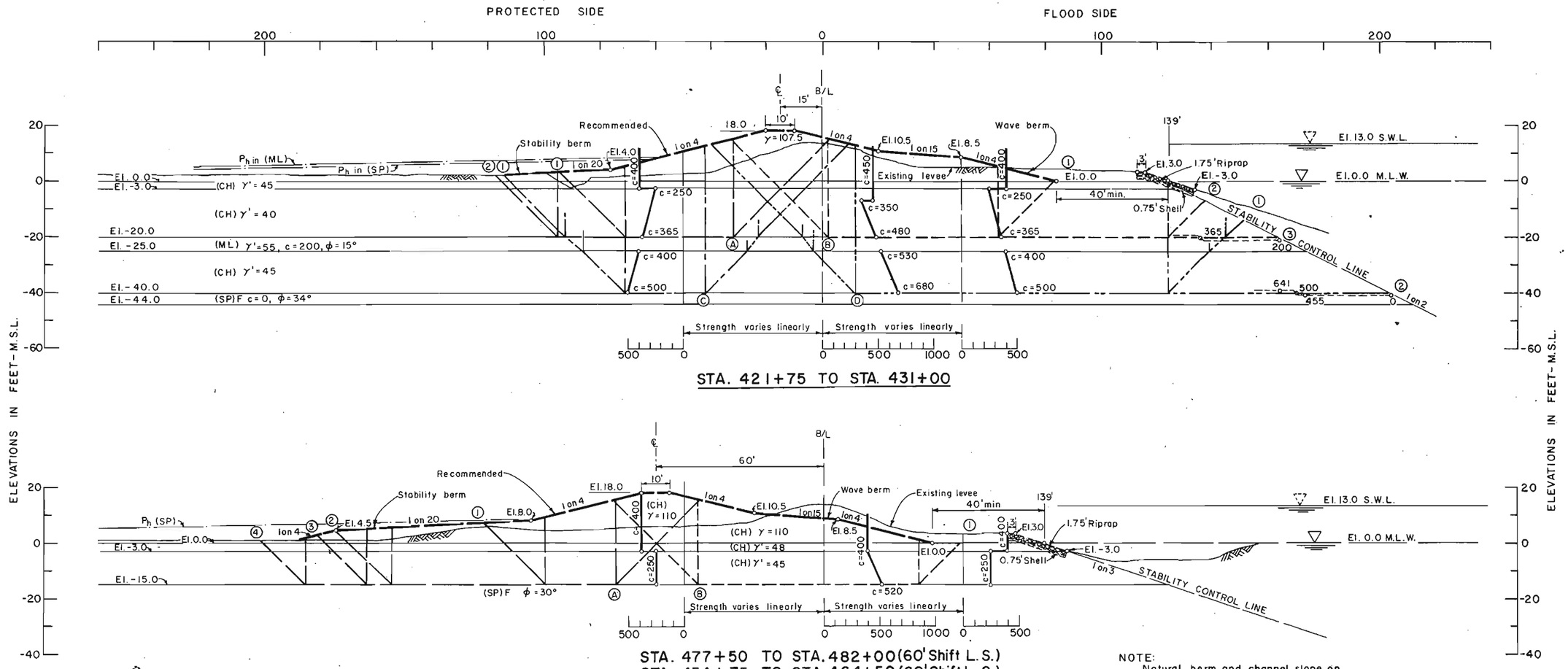
STABILITY CALCULATIONS

FEATURE	SLIP SURFACE NUMBER		EL. M.S.L.	DRIVING +$\bar{C}_D$	DRIVING -$\bar{B}_D$	DRIVING $\Sigma\bar{D}$	RESISTING +$\bar{R}_A$	RESISTING +$\bar{R}_B$	RESISTING +$\bar{R}_D$	RESISTING $\Sigma\bar{R}$	FACTOR OF SAFETY $\Sigma\bar{R}/\Sigma\bar{D}$
LEVEE (O) STABILITY	A	1	-14	30,533	13,609	16,924	10,622	4,818	7,014	22,454	1.34
		2	-22	72,643	48,467	24,196	19,858	7,003	12,075	38,330	1.46
		3	-44	153,702	101,549	52,153	30,902	10,970	21,300	63,172	1.95
	B	1	-14	18,858	6,841	14,017	12,400	3,286	6,464	22,150	1.58
		2			1,044	17,814		4,610	2,850	29,860	1.72
	C	1	-22	38,886	8,464	30,422	18,880	21,180	8,464	48,484	1.59
		2			4,876	34,010		27,045	8,560	54,445	1.58
		3			1,810	37,076		30,870	8,280	54,970	1.48
	D	1	-44	83,688	23,112	60,576	30,692	25,985	15,450	72,127	1.78
		2			5,000	55,868		39,675	8,925	79,292	1.47

NOTE:
Sta. 255+10 to 255+90 is "T" Wall with sheet pile cut off to El. -9.5'

For general notes see Plates 37 and 44

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LEVEE (O) AND WALL (S) STABILITY ANALYSES
VIC. BULK LOADING PLANT
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. M-2-23806



STA. 421+75 TO STA. 431+00

STA. 477+50 TO STA. 482+00 (60' Shift L.S.)
STA. 454+75 TO STA. 464+50 (60' Shift L.S.)
STA. 466+20 TO STA. 476+50 (90' Shift L.S.)

NOTE:
Natural berm and channel slope on flood side will be preserved, broken lines are stability control lines.

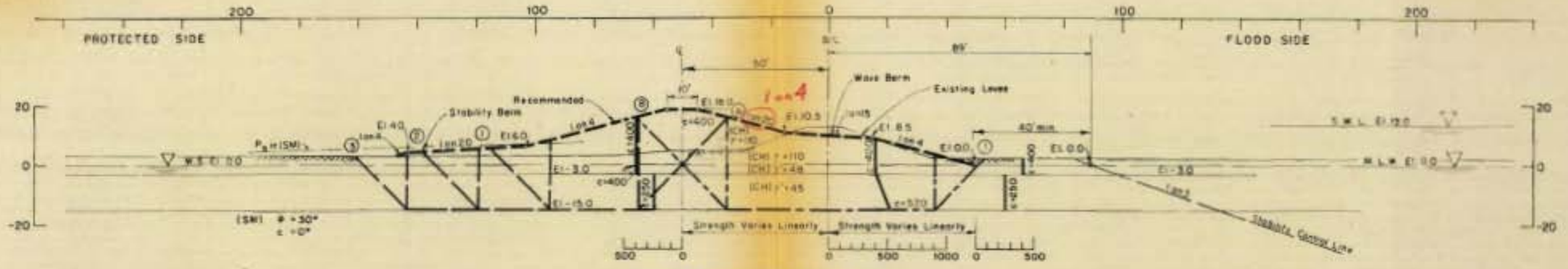
431+00 ?

STABILITY CALCULATIONS

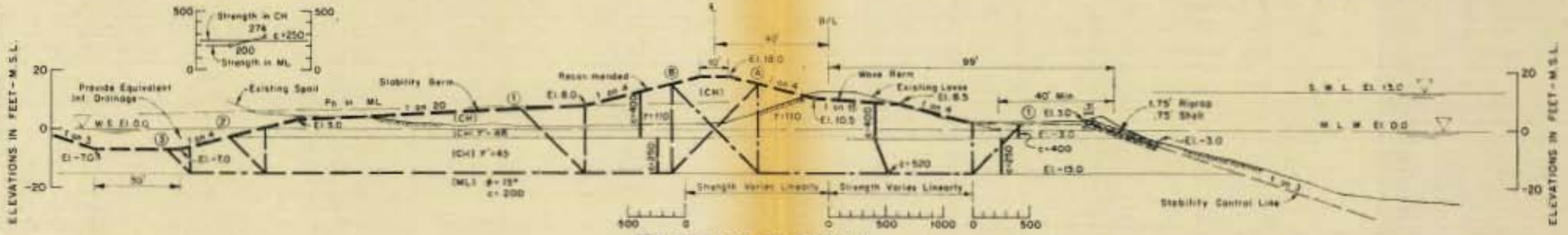
LEVEE STATION	SLIP SURFACE NUMBER		EL. M.S.L.	DRIVING $+\bar{D}_A$	DRIVING $-\bar{D}_P$	DRIVING $\Sigma\bar{D}$	RESISTING $+R_A$	RESISTING $+R_B$	RESISTING $+R_P$	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma\bar{D}$
437+00 (15' Shift) L.S.	A	1	-20	59,880	16,447	43,433	27,336	14,613	15,405	57,354	1.32
		2			12,739	47,141		23,373	14,445	65,154	1.38
	B	1	-20	59,880	14,996	44,884	28,623	24,953	12,855	66,431	1.48
		2			5,250	54,630		47,218	8,289	84,130	1.54
		3			0	59,880		59,522	0	88,145	1.47
	C	1	-40	107,668	44,595	63,073	46,945	14,444	34,510	95,899	1.52
	D	1	-40	107,668	23,687	83,981	49,039	58,622	21,608	129,269	1.54
		2			0	107,668		91,122	0	140,161	1.30
458+38.9 (60' Shift) L.S.	A	1	-15	49,470	21,046	28,424	20,400	6,250	14,160	40,810	1.44
		2			15,579	33,891		20,000	12,400	52,800	1.56
		3			14,501	34,969		22,250	10,400	53,050	1.52
		4			6,889	42,581		27,750	9,600	57,750	1.36
	B	1	-15	49,470	5,525	43,945	20,540	32,507	9,600	62,647	1.43

NOTE:
For general notes see Plate 37

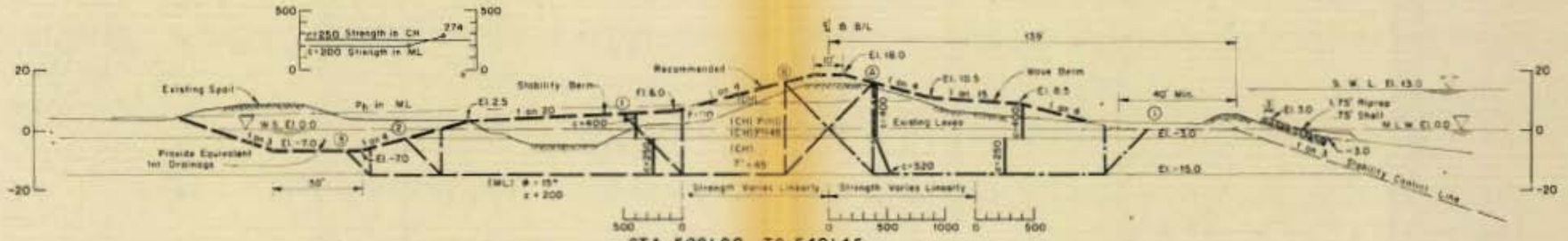
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LEVEE (Q) STABILITY
STA. 421+75 TO STA. 431+00
STA. 454+75 TO STA. 482+44.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908



STA. 483+00 TO STA. 492+29



STA. 495+70 TO 507+00
STA. 584+18.6 TO 594+50.0



STA. 508+00 TO 540+45

STABILITY CALCULATIONS

LEVEE STATION	SLIP SURFACE NUMBER		EL	τD_A	DRIVING $-D_m$	DRIVING ΣD	RESISTING $+R_A$	RESISTING $+R_B$	RESISTING $+R_C$	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma D$
482+44.7 TO 494+29.5	A	1	-15	49,470	17,634	3,636	20,800	7,500	12,900	41,400	1.30
		2			14,028	35,442		13,800	11,880	46,080	1.30
		3			10,849	38,631		13,500	10,800	51,100	1.32
	B	1			9,474	40,566	27,712	30,103	9,269	61,084	1.51
506+44.7	A	1	-15	49,679	16,379	33,300	21,010	7,500	13,800	42,310	1.27
		2			4,162	45,517		35,290	6,000	62,300	1.37
		3			0	49,679		40,950	6,000	67,960	1.37
	B	1			6,174	43,505	27,886	30,575	10,000	68,461	1.46
533+44.7	A	1	-15	49,679	16,129	33,451	24,680	12,075	12,600	49,355	1.47
		2			4,232	45,047		32,575	6,000	63,255	1.39
		3			0	49,679		37,725	6,000	68,405	1.34
	B	1			5,734	43,945		23,075	6,600	54,355	1.24

NOTE

The levee stability was also checked with W.S. in the L.S. pit at elev. -7.0, and found to have an F.S. greater than 1.3.

For general notes see Plate 37.

Natural berm and channel slope on flood side will be preserved, broken lines are stability control lines. (Except stability enlargement)

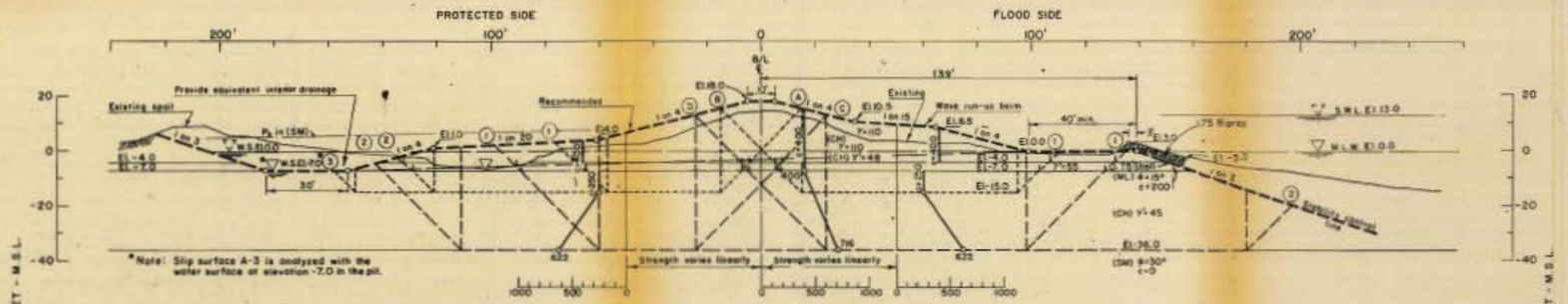
LAKE PONTCHARTRAIN AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

LEVEE (Q) STABILITY

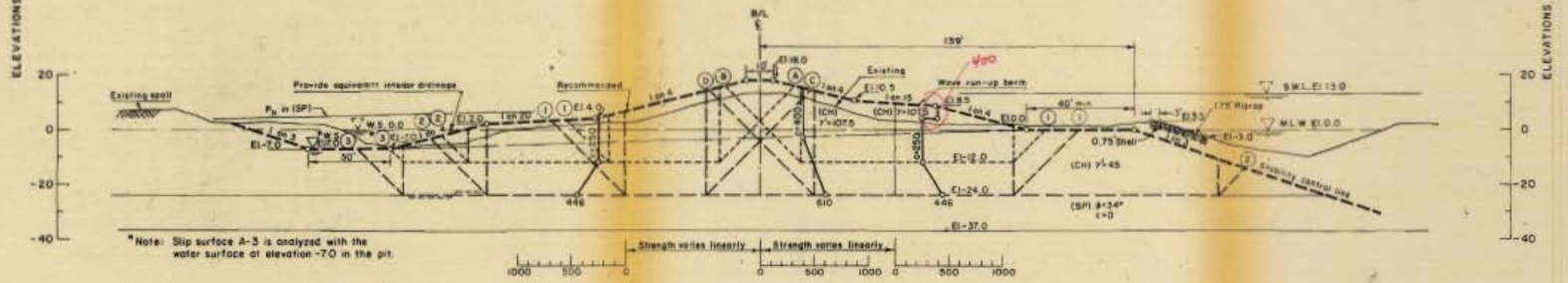
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

August 1967 FILE NO. H-2-23908

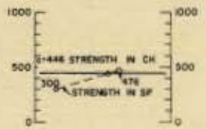
PLATE 40



STA. 541+45 TO STA. 557+50



STA. 558+50 TO STA. 571+60



STA. 558+50 TO STA. 571+60

STABILITY CALCULATIONS

LEVEE STATION	SLIP SURFACE NO.	EL.	DRIVING +D_a	DRIVING -D_p	DRIVING ΣD	RESISTING +R_a	RESISTING +R_p	RESISTING +R_p	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma D$
541+447	1		50,022	12,018	38,004	25,454	13,230	12,545	51,229	1.35
	A 2	-15		4,734	45,288		29,230	7,189	61,873	1.37
	3*		53,000	1,563	51,437	25,725	36,480	4,000	66,205	1.29
	B 1	-15	50,022	5,720	44,302	25,454	22,730	9,340	57,524	1.30
	C 1	-36	108,246	41,917	66,329	48,303	23,015	28,543	99,862	1.51
	2			29,816	78,430		54,738	23,112	126,153	1.59
	D 1	-36	108,246	29,660	78,586	48,303	48,652	27,852	122,807	1.56
	2			8,415	99,831		97,656	15,840	161,799	1.62
563+947	1		41,349	9,235	32,114	22,670	13,190	7,750	43,610	1.36
	A 2	-12		2,700	38,649		26,198	4,750	53,618	1.39
	3*		43,903	653	43,250		32,190	2,500	57,360	1.33
	B 1	-12	41,349	3,643	37,706	22,670	22,690	6,000	51,360	1.36
	1			24,570	45,795		14,850	15,852	63,950	1.40
	C 2	-24	70,365	12,355	58,010	33,248	37,596	12,802	83,446	1.44
	3			6,638	63,727		50,035	10,852	94,135	1.48
	D 1			13,363	57,002		34,474	14,352	82,074	1.44
	2	-24	70,365	3,150	67,215	33,248	59,370	7,280	108,898	1.62

Note: For general notes, see plate 37

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
I.H.N.C. THRU NASA

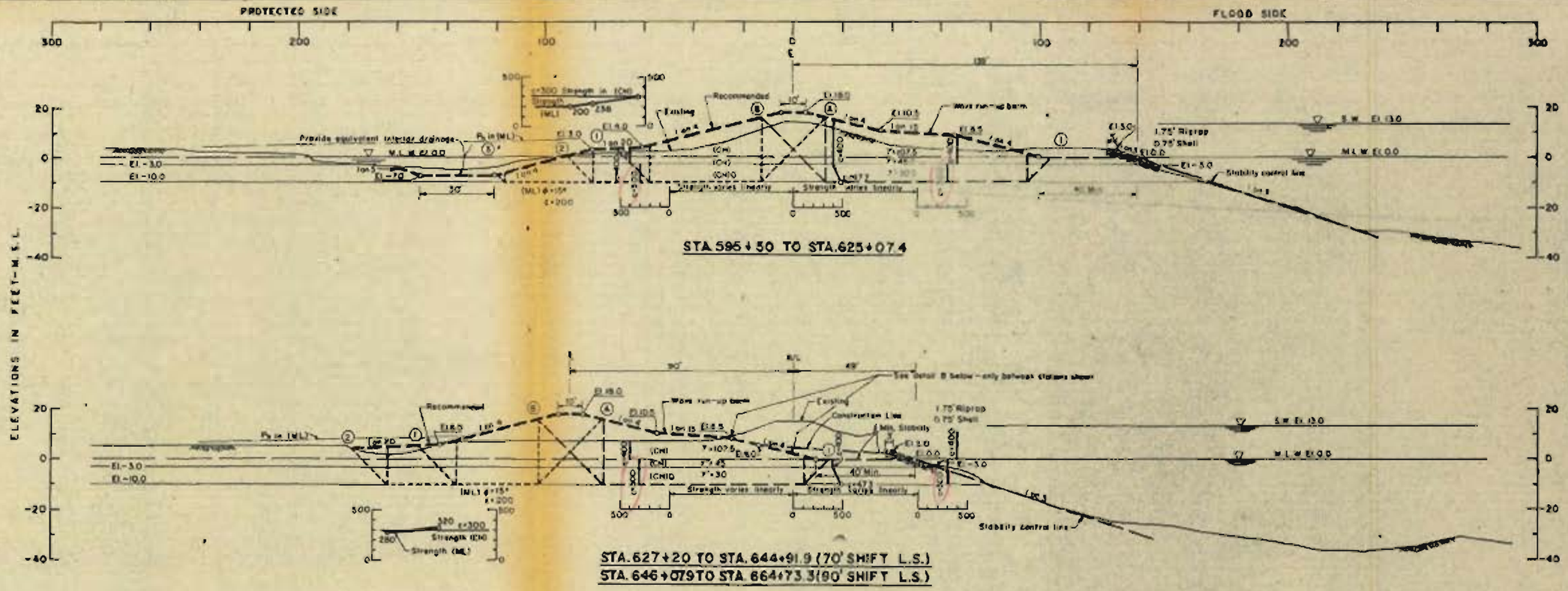
LEVEE (Q) STABILITY

STA. 541+45 TO STA. 571+60

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-23908

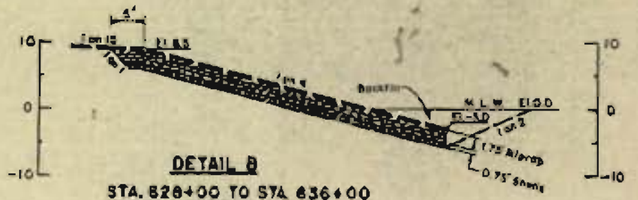
PLATE 41



STA 595+50 TO STA.625+07.4

STA.627+20 TO STA.644+91.9 (70' SHIFT L.S.)
STA.646+07.9 TO STA.664+73.3 (90' SHIFT L.S.)

LEVEE STATION	SLIP SURFACE NO.		EL.	DRIVING $+D_s$	DRIVING $-D_p$	DRIVING ΣD	RESISTING $+R_s$	RESISTING $+R_s$	RESISTING $+R_p$	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma D$
623+44.7	A	1	-10	36,713	6,666	30,047	20,954	15,758	9,000	45,712	1.52
		2			3,656	33,057		22,210	8,600	49,764	1.50
		3			0	36,713		28,581	1,800	52,335	1.43
	B	1			2,216	34,497		26,868	6,600	54,222	1.57
647+44.7	A	1	-10	34,713	10,590	24,123	18,600	9,500	9,300	38,000	1.45
		2			6,204	28,509		18,220	9,800	48,620	1.64
	B	1			2,286	34,427		29,314	8,934	56,338	1.63



DETAIL B

STA. 628+00 TO STA 636+00

(This reach has experienced loss of berm due to severe wave attack and protective shown is to preserve integrity of levee.)

NOTE:
For general notes see plate 37

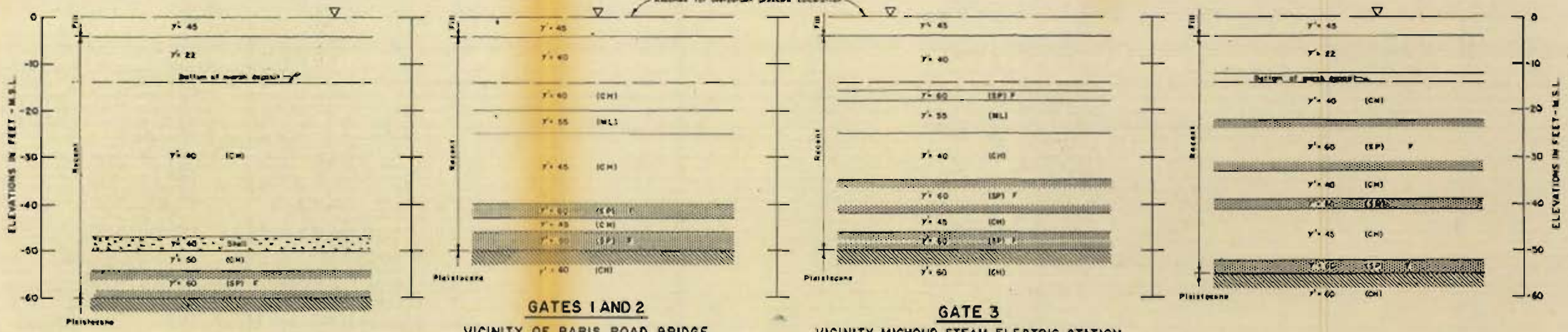
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

LEVEE (Q) STABILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. N-2-23908

PLATE 42



VICINITY OF BULK LOADING PLANT

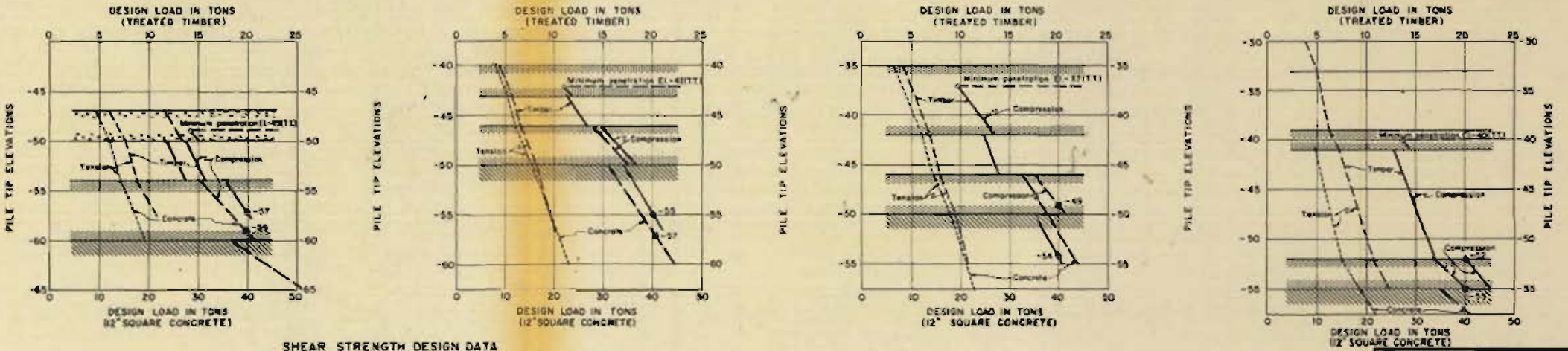
GATES 1 AND 2

VICINITY OF PARIS ROAD BRIDGE AND MICHOUD STEAM ELECTRIC STATION

GATE 3

VICINITY MICHOUD STEAM ELECTRIC STATION PUMPING STATION

VICINITY OF MICHOUD PUMPING STATION



SHEAR STRENGTH DESIGN DATA

Applied factors of safety - 1.75 in compression and 2.0 in tension.
Applied conjugate stress ratios K=1.0 in compression and 0.7 in tension.
(S) Strengths (critical condition):
Clays (CH), Recent $\phi = 23°$, $c = 0$; Pleistocene, $\phi = 25°$, $c = 0$.
Silts (ML), $\phi = 25°$, $c = 0$.
Sands (Fine) (SP)F and Silty Sand (SM), $\phi = 34°$, $c = 0$.
Shells (SI), $\phi = 40°$, $c = 0$.

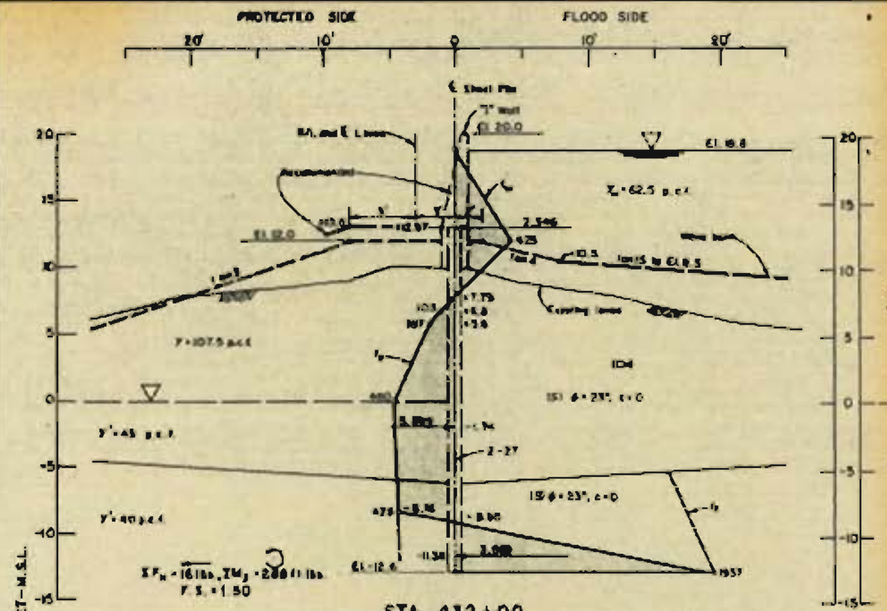
DESIGN LOAD VS TIP ELEVATION

NOTE
Skin friction disregarded above elevation -14.0

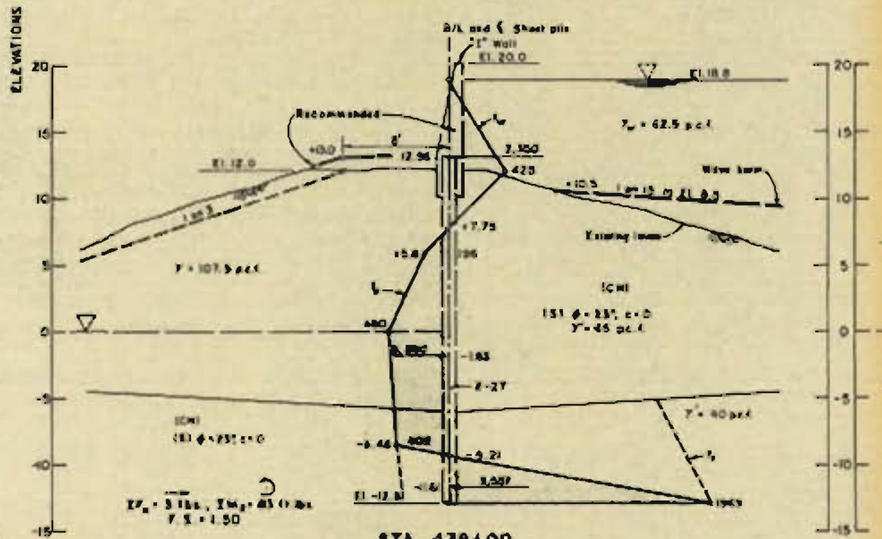
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

PILE DESIGN LOAD VS TIP ELEVATION
CLASS B, TREATED TIMBER & 12" SQUARE PRESTRESSED CONCRETE PILES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967 FILE NO H-2-23906

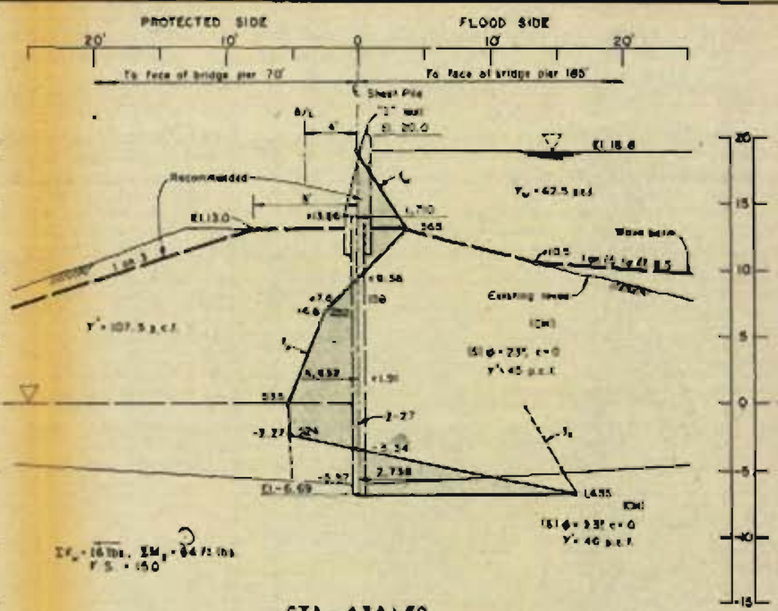
PLATE 43



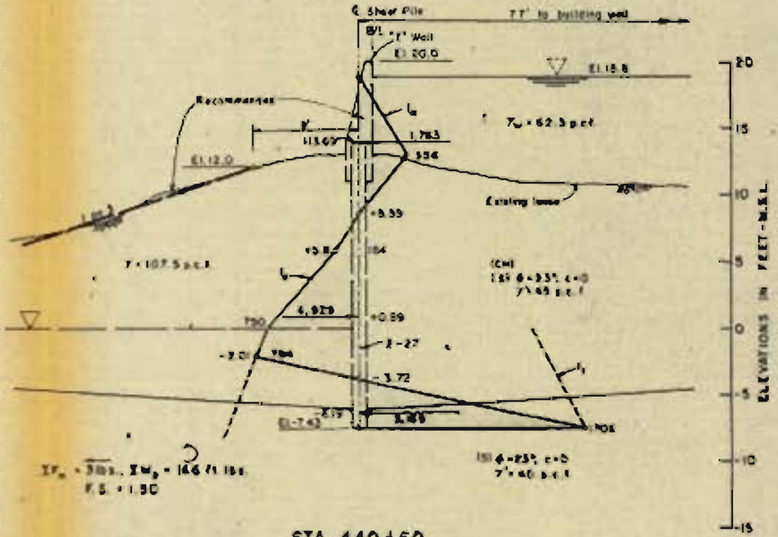
STA. 432+00
VICINITY PARIS ROAD



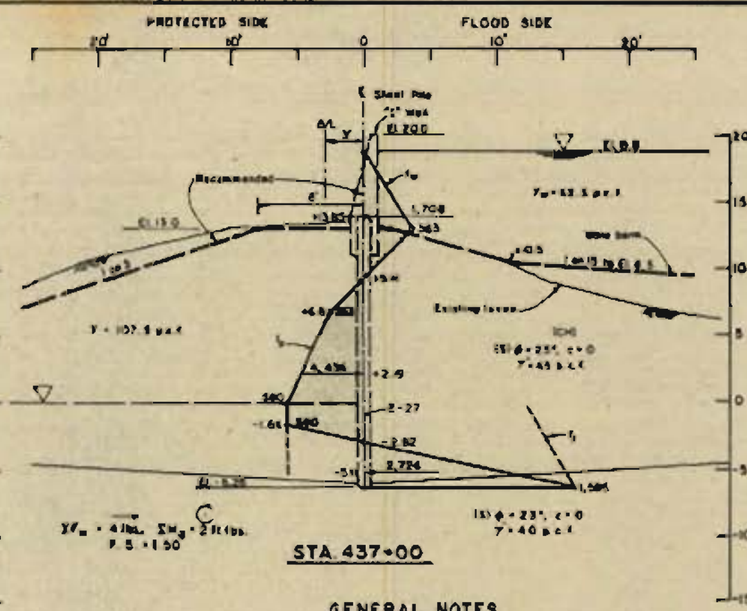
STA. 438+00



STA. 434+50
BENEATH STATE HWY. 47 BRIDGE



STA. 440+60
MICHOUD STEAM ELECTRIC STATION



STA. 437+00

GENERAL NOTES

(S) – Shear strength case governed for design.
Cantilever sheet pile floodwall stability programmed and these analyses were run on computer.
Stability analysis by the method of planes with failure surfaces $45° \pm \frac{\phi_a}{2}$ and F.S. = 1.50 applied to the (S) shear strength of the soil.

ϕ_a – Available angle of internal friction in degrees.

ϕ_d – Developed angle of internal friction = $\tan^{-1}\left(\frac{\tan \phi_a}{F.S.}\right)$

C_a – Unit cohesion available.

C_d – Unit cohesion developed = $C_a \div F.S.$

(S) – Consolidated - drained shear strength of soil.
For undisturbed shear test data see plates.

f_w – Net lateral water pressure.

f_l – Net lateral pressure on floodside = earth + f_w

f_p – Net lateral pressure on protected side = earth – f_w

ΣF_H – Summation of horizontal forces.

ΣM_B – Summation of moments about the sheet pile tip.

$\gamma, \gamma' B, \gamma_w$ – Unit weights.

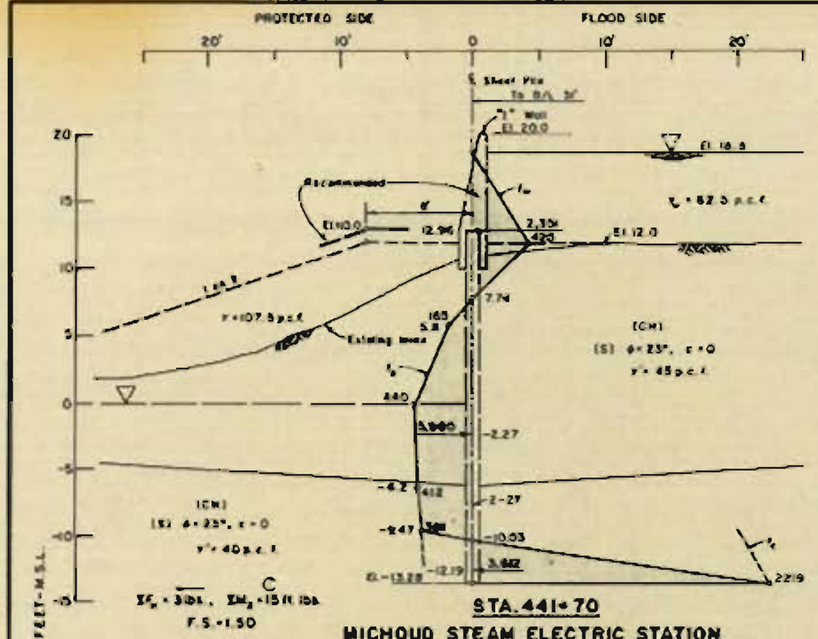
H – Static water head above levee crown.

D – Penetration of tip below crown.

S.W.L. – Still water level = El. 13.0

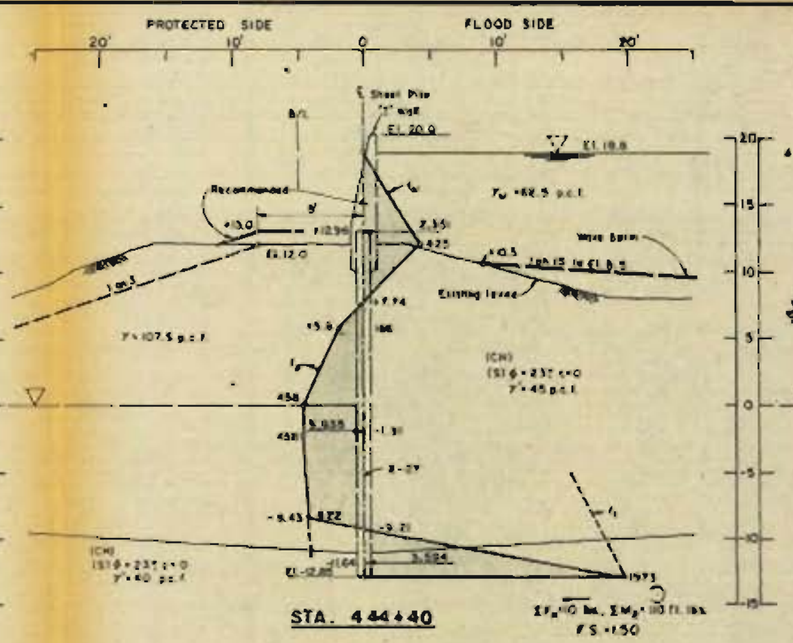
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
INNC THRU NASA
CANTILEVER SHEET PILE FLOODWALL (S) STABILITY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
August 1959
FILE NO. N-2-23908

PLATE 44

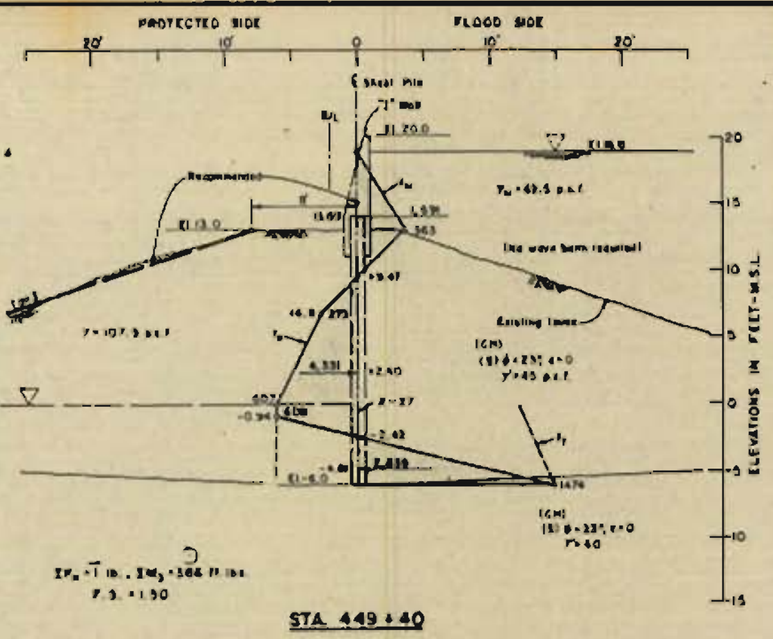


STA. 441+70

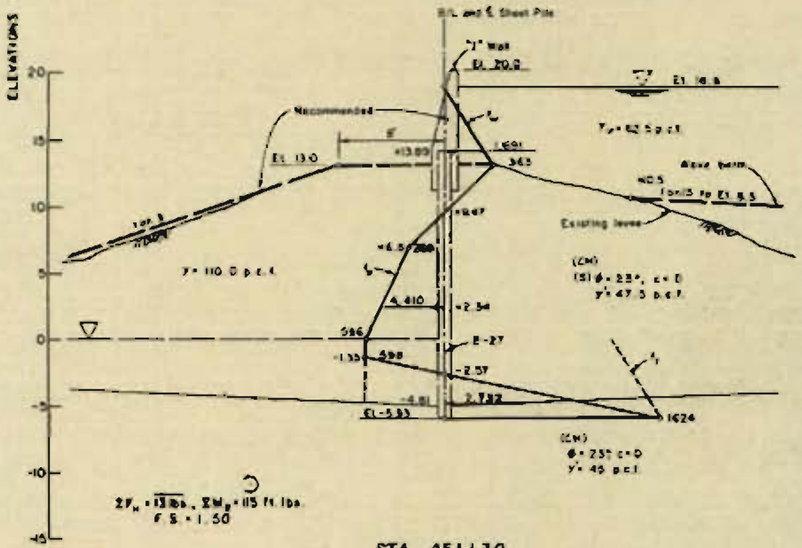
MICHOUD STEAM ELECTRIC STATION



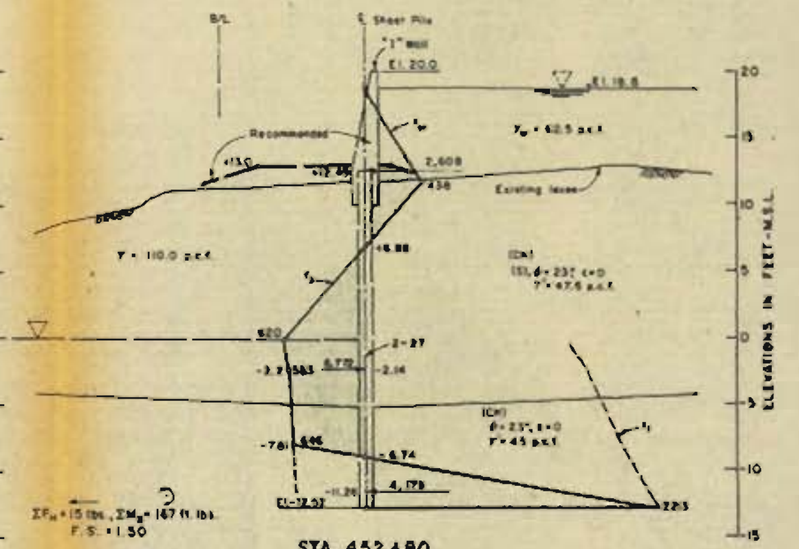
STA. 444+40



STA. 449+40



STA. 451+30



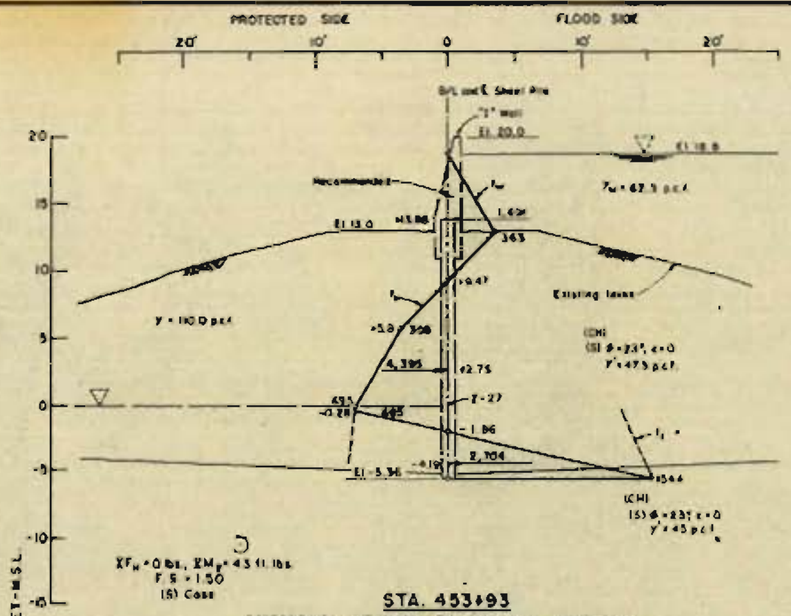
STA. 452+80

MICHOUD STEAM ELECTRIC STATION

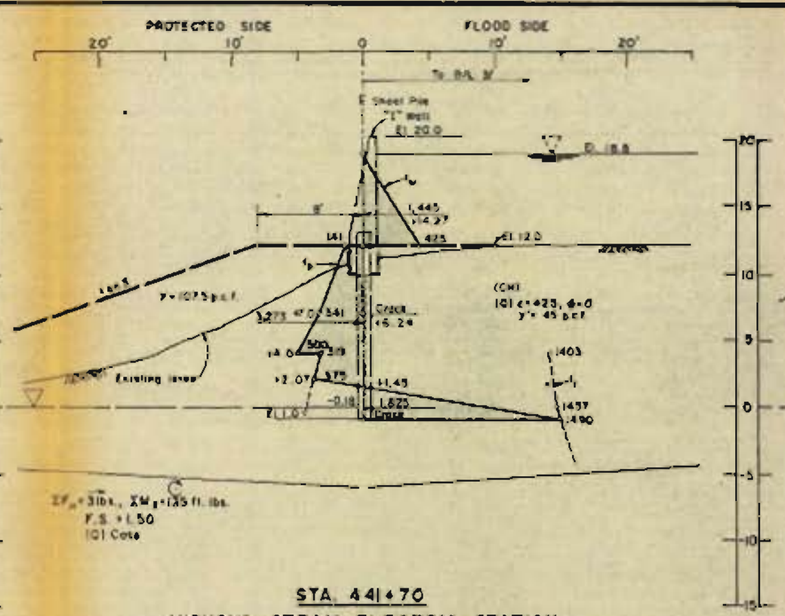
For general notes see page 44

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
CANTILEVER SHEET PILE
FLOODWALL (S) STABILITY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUDLEY DAY
FILE NO. N-2-23908

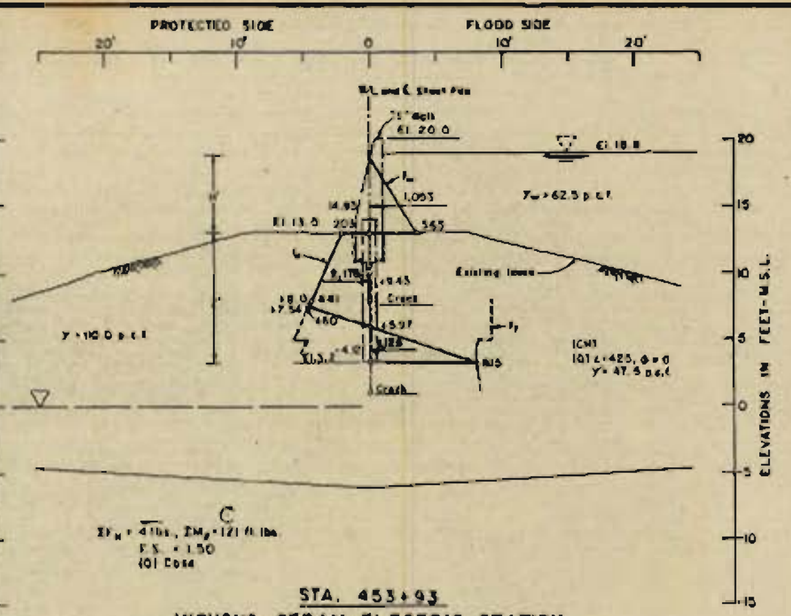
PLATE 45



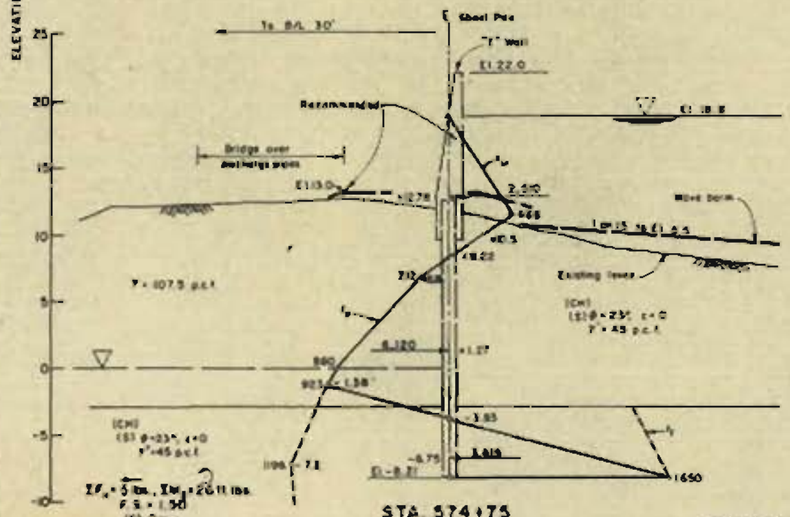
STA. 453+93
MICHOUD STEAM ELECTRIC STATION
PUMPING STATION
(I-WALL ENDS AT STA. 454+821)



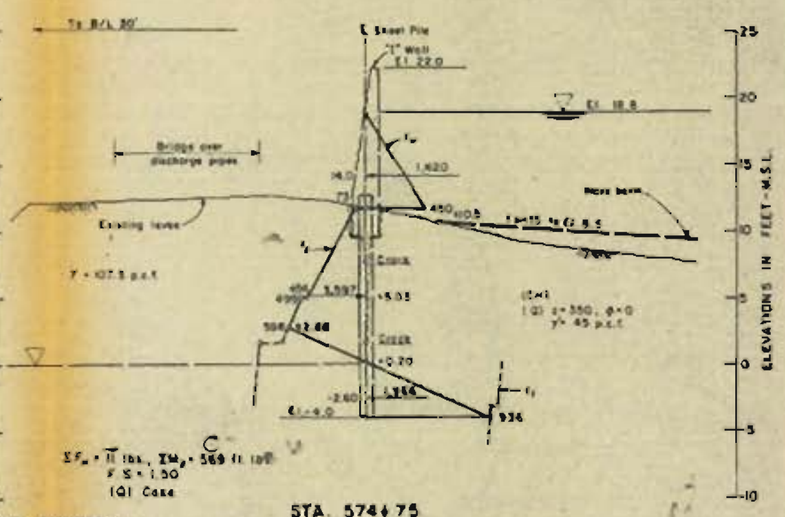
STA. 441+70
MICHOUD STEAM ELECTRIC STATION



STA. 453+93
MICHOUD STEAM ELECTRIC STATION
PUMPING STATION

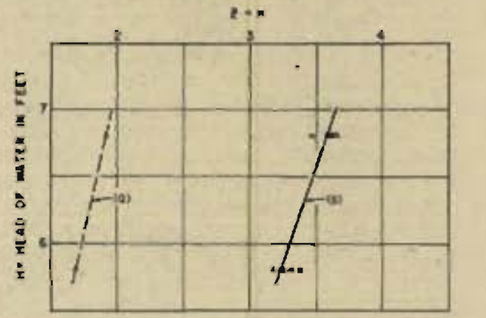


STA. 574+75
(STA. 571+53 TO STA. 584+236)



STA. 574+75

MICHOUD PUMPING STATION



H VS. Z = H
(NO DYNAMIC WAVE FORCE)

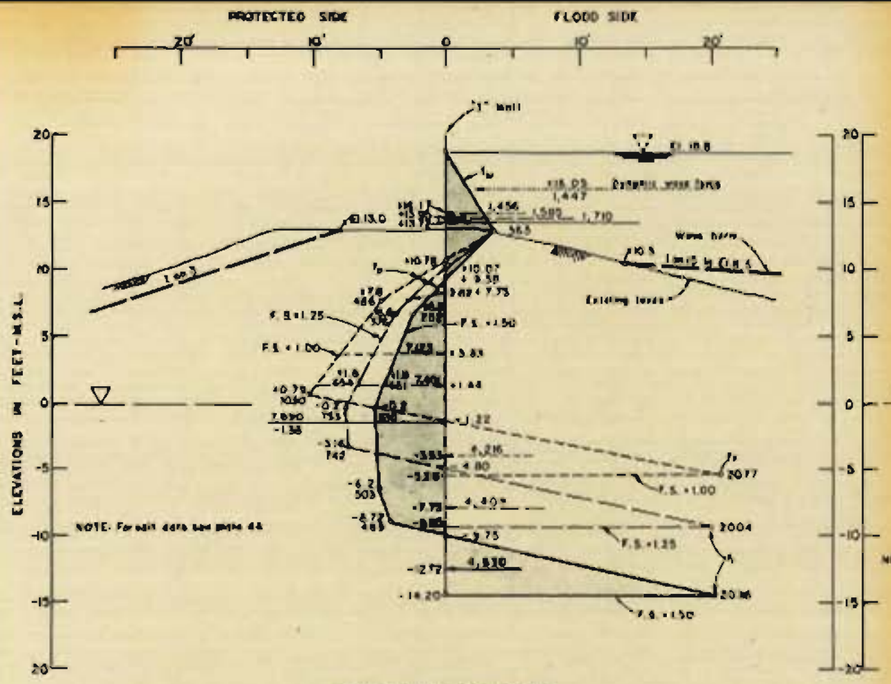
For general notes see plate 44

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA

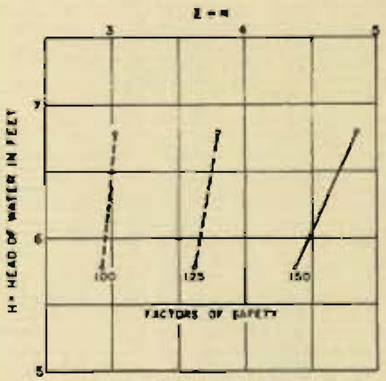
CANTILEVER SHEET PILE FLOODWALL (S) AND (Q) STABILITY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 46

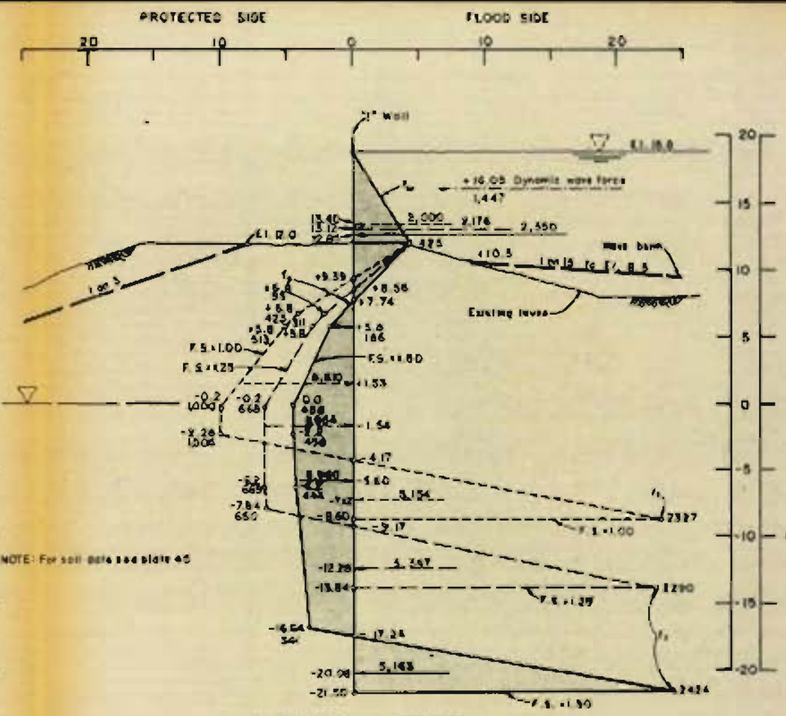


PRESSURE DIAGRAMS
STA. 434+50

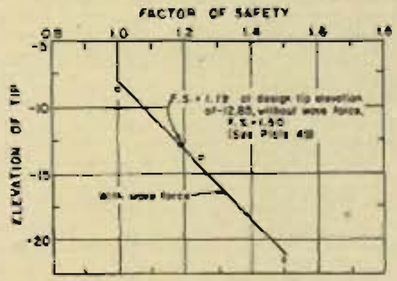


H VS Z ÷ H
(WITH DYNAMIC WAVE FORCE)

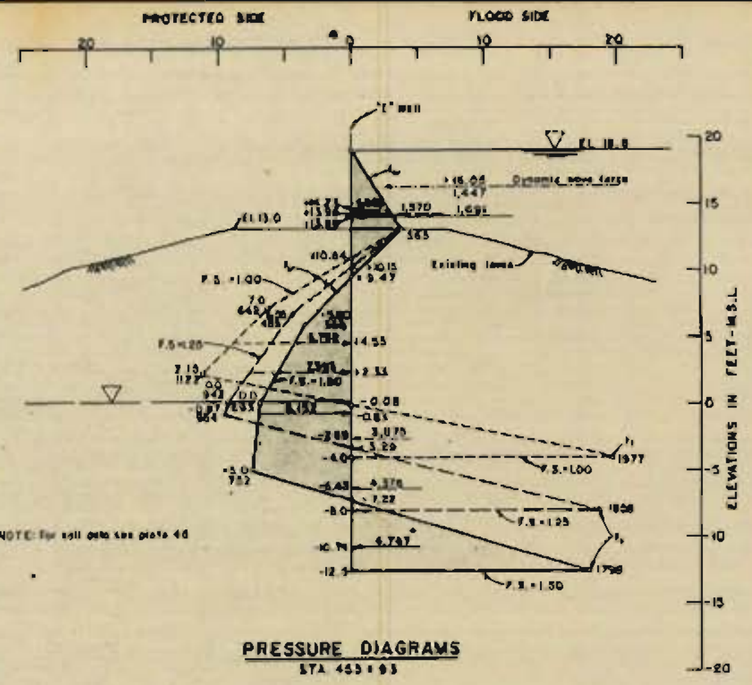
TIP ELEVATION VS F.S.
STA. 434+50



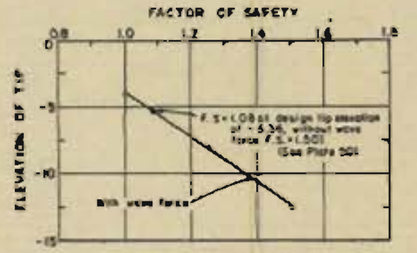
PRESSURE DIAGRAMS
STA. 444+40



TIP ELEVATION VS F.S.
STA. 444+40



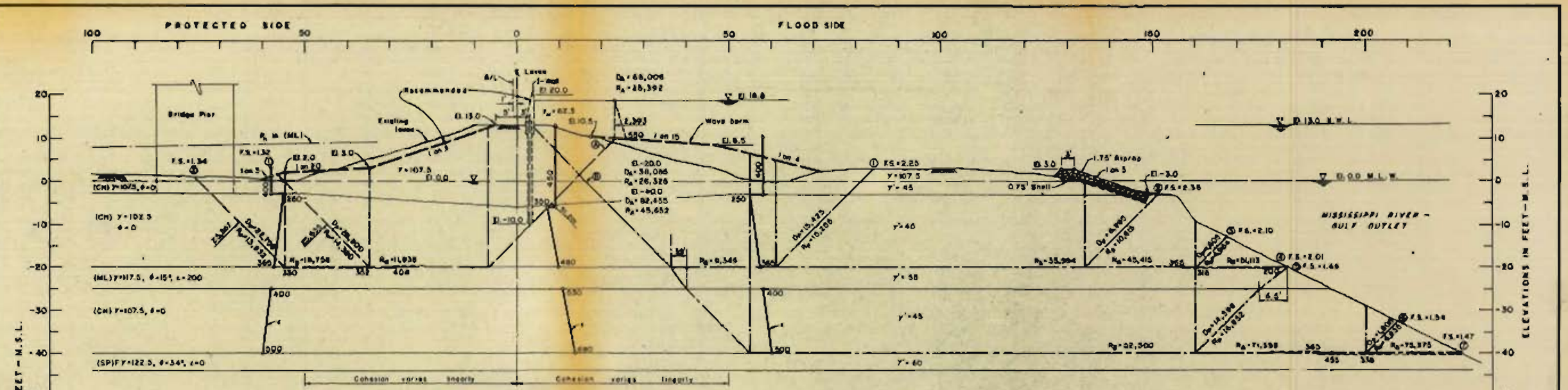
PRESSURE DIAGRAMS
STA. 453+93



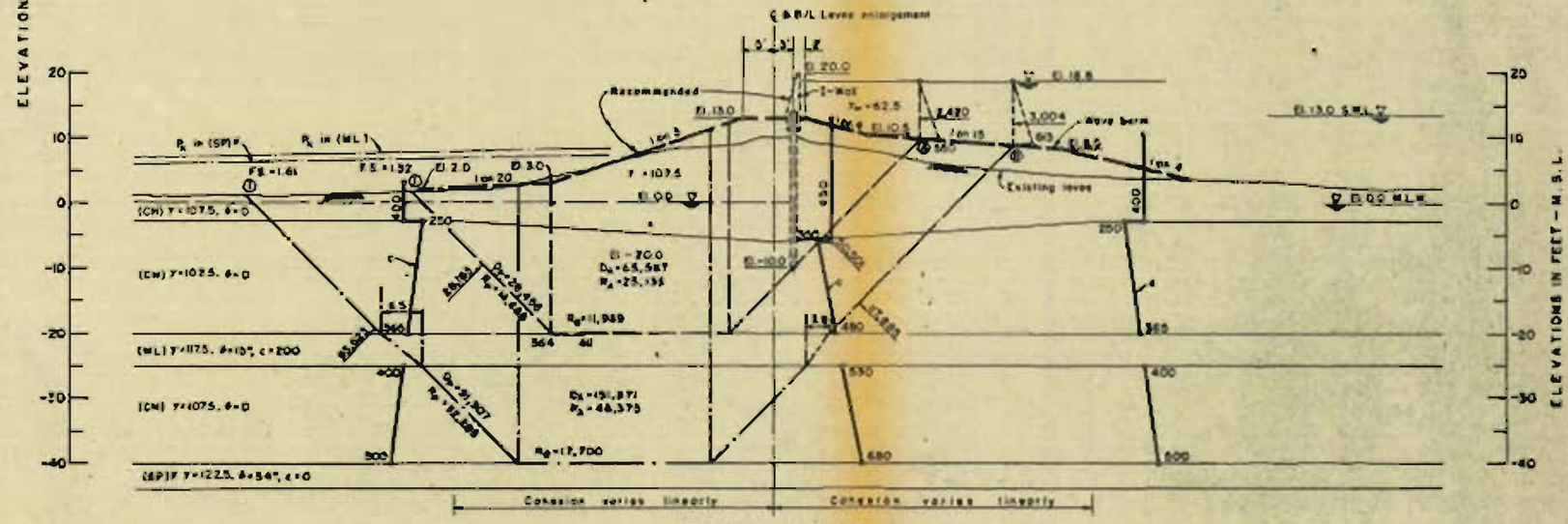
TIP ELEVATION VS F.S.
STA. 453+93

For general notes see plate 44

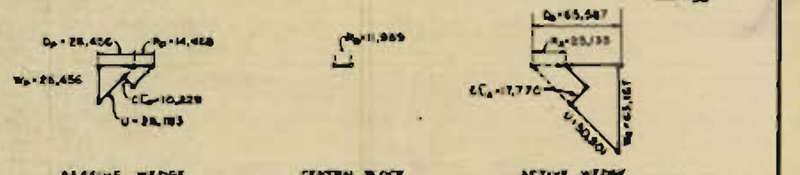
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
INNC THRU NASA
CANTILEVER SHEET PILE FLOODWALL (S) STABILITY WITH DYNAMIC WAVE FORCE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967 FILE NO. M-2-23908



STATION 434+50
BENEATH LA. STATE HWY. 47 BRIDGE



STATION 432+00



$$FS = \frac{\Sigma R}{\Sigma D} = \frac{R_A + R_B + R_C}{D_A - D_P} = 1.32$$

STATION 432+00, SLIP SURFACE Ⓐ-①

TYPICAL VECTOR ANALYSIS

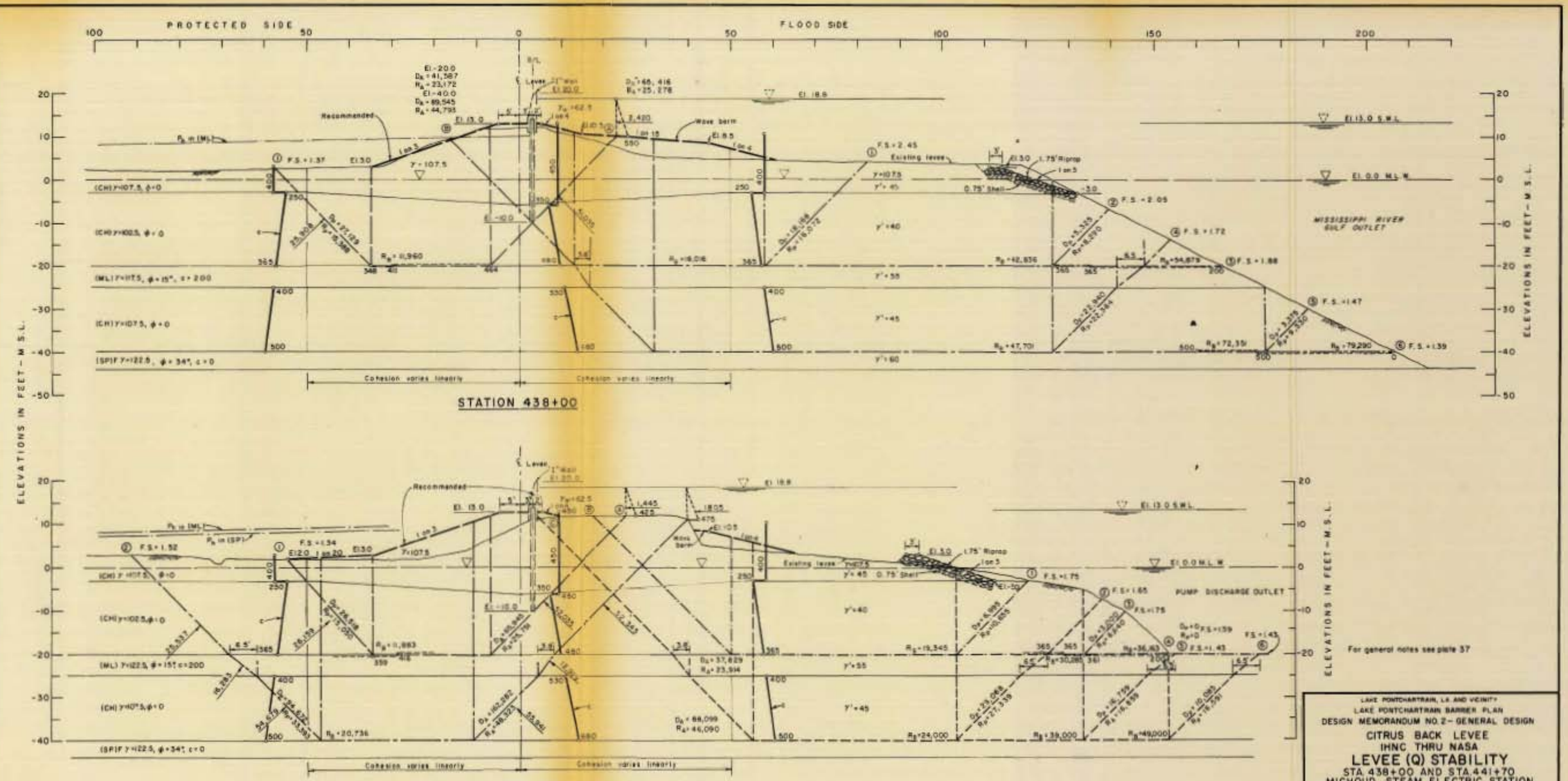
For general notes see plate 37

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
CITRUS BACK LEVEE
INNC THRU NASA

LEVEE (Q) STABILITY
STA. 432+00 TO STA. 434+50

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

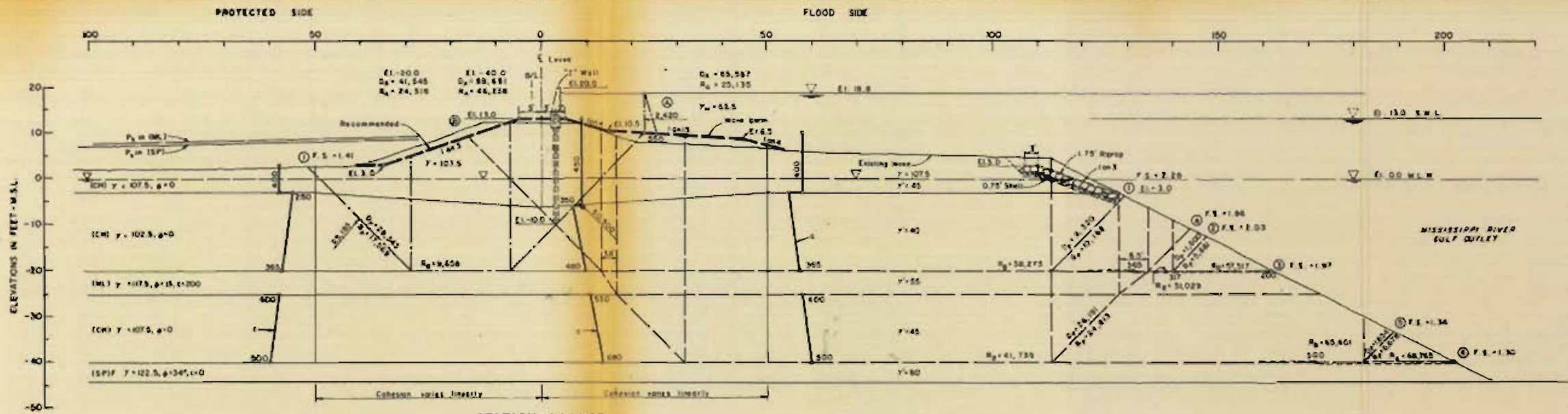
AUGUST 1967 FILE NO. M-2-21808



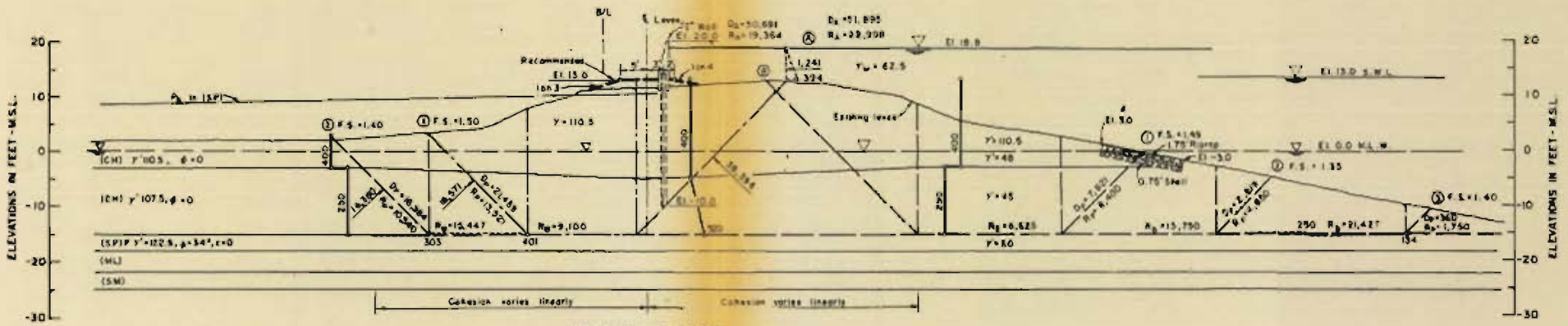
For general notes see plate 37

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LEVEE (Q) STABILITY
STA. 438+00 AND STA. 441+70
MICHOUD STEAM ELECTRIC STATION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 49



STATION 444+40

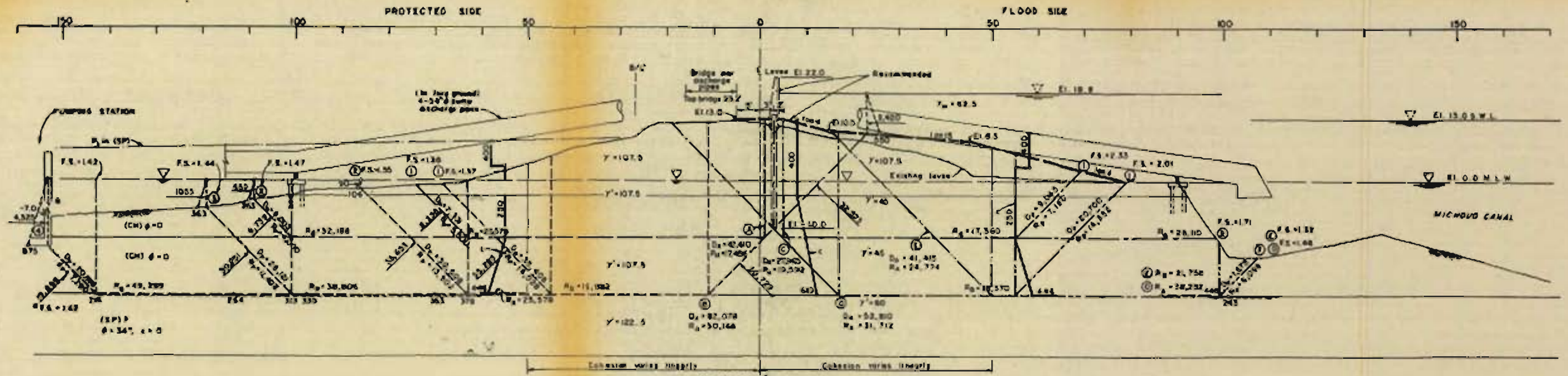


STATION 452+80
MICHOUD STEAM ELECTRIC STATION

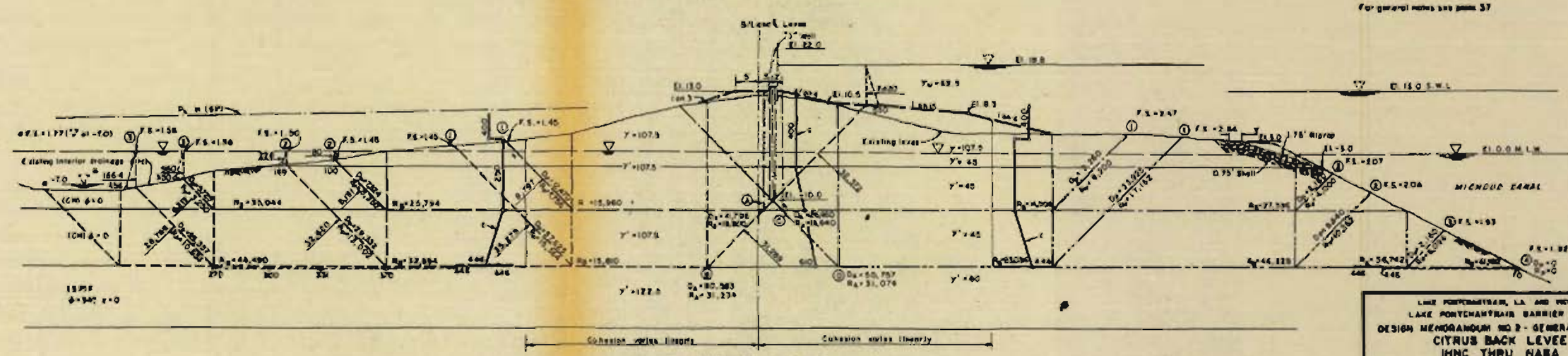
For general notes see plate 37

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LEVEE (Q) STABILITY
STA. 444+40 AND STA. 452+80
MICHOUD STEAM ELECTRIC STATION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987
FILE NO. H-2-25908

PLATE B0



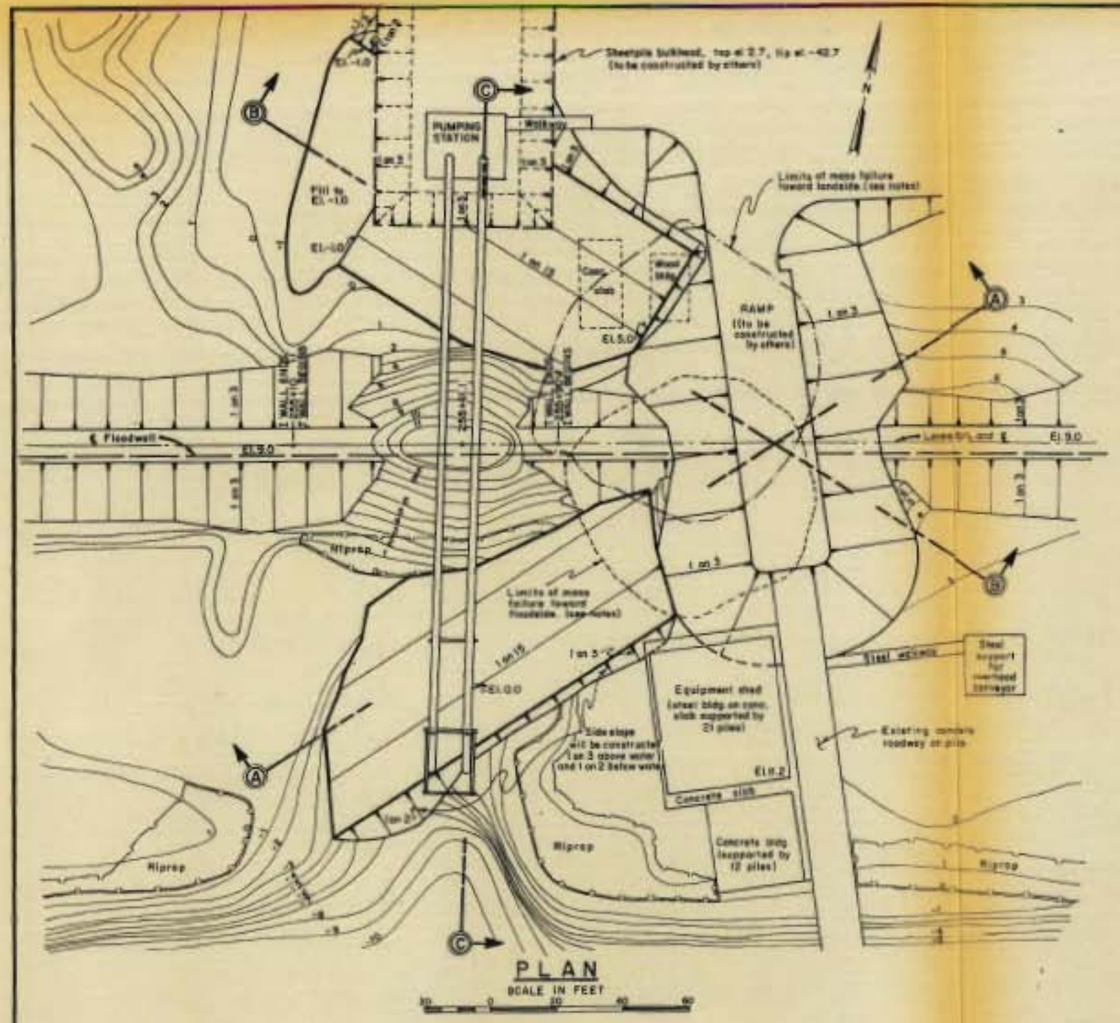
STATION 574+75
MICHOUD PUMPING STATION

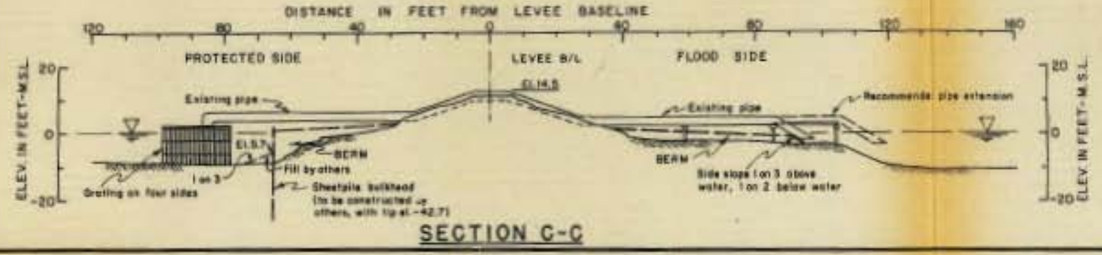


STATION 581+00
VICINITY OF CHRYSLER HIGH PRESSURE
TESTING FACILITY

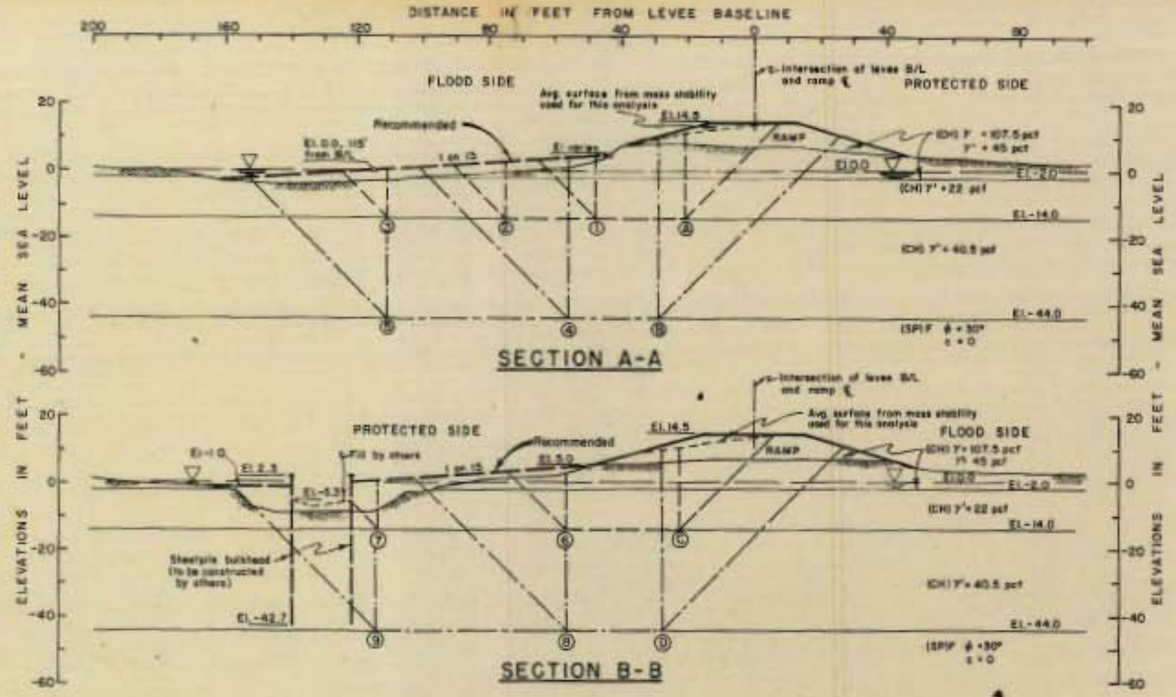
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
LEVEE (Q) STABILITY
STA 574+75 MICHOUD PUMPING STATION
STA 581+00 CHRYSLER TESTING FACILITY
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. M-2-23908

PLATE 51



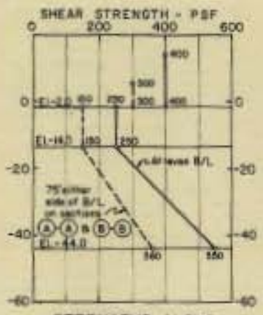


SECTION C-C



SECTION A-A

SECTION B-B



STRENGTHS ALONG SECTIONS A-A & B-B

STABILITY CALCULATIONS

SECTION	SLIP SURFACE NUMBER		ELEV	DRIVING +D_a	DRIVING -D_p	DRIVING ΣD	RESISTING +R_a	RESISTING +R_s	RESISTING +R_p	RESISTING ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma D$
Ⓐ-Ⓐ	Ⓐ	①	-14	31,510	9,129	22,381	18,612	5,508	7,945	32,065	1.43
		②	-14	31,510	6,226	25,284	18,612	11,621	6,400	36,633	1.44
		③	-14	31,510	2,903	28,607	18,612	17,021	5,290	40,923	1.41
	Ⓑ	④	-44	100,614	44,396	56,218	37,435	11,948	22,112	71,495	1.27
		⑤	-44	100,614	31,002	69,612	37,435	32,211	19,500	89,146	1.28
Ⓑ-Ⓑ	Ⓒ	⑥	-14	30,435	9,720	20,715	18,525	6,797	7,719	33,041	1.60
		⑦	-14	30,435	3,794	26,641	18,525	15,563	3,300	37,388	1.40
	Ⓓ	⑧	-44	101,743	46,636	55,107	37,812	12,947	22,268	72,927	1.32
		⑨	-44	101,743	30,213	71,530	37,812	34,141	21,300	93,253	1.30

NOTE: Mass failures were analyzed based on wedges Ⓐ-① and Ⓒ-⑥ using 56 foot width. The analyses were made for existing condition without berms and resulted in factors of safety of 1.68 and 1.75, respectively.

The driving forces, D_a, for the one foot width analyses shown above were determined based on the average ground surfaces from the mass stability analyses.

See plate 13 for floodwall details.

LAKE PONTCHARTRAIN, LA. AND VICINITY
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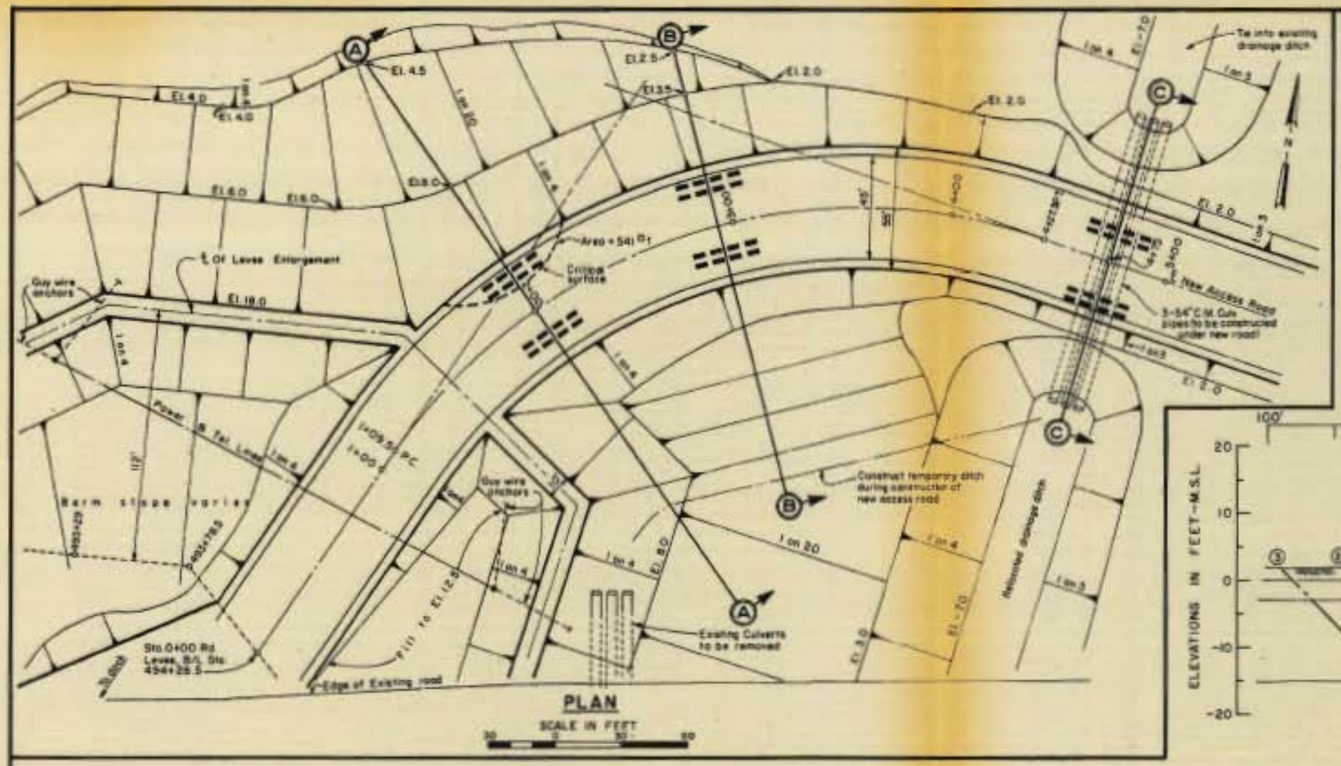
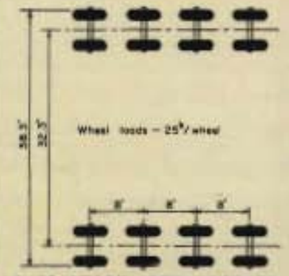
ROAD RAMP AT BULK LOADING PLANT, (Q) STABILITY

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

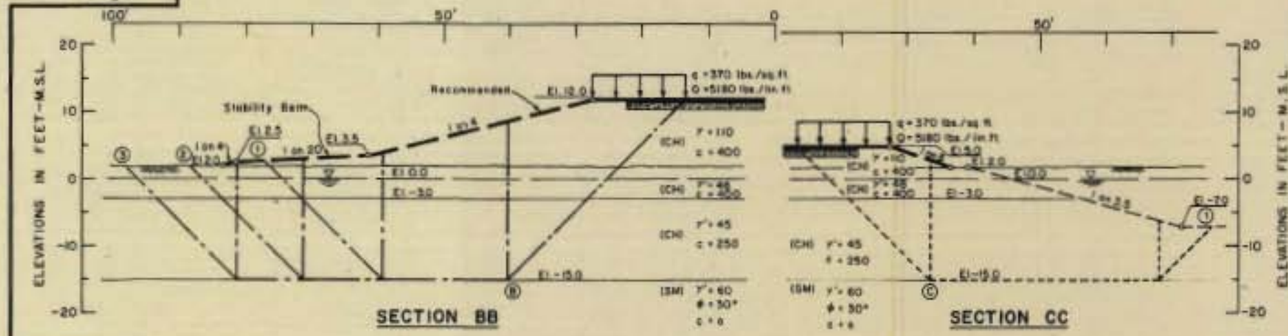
AUGUST 1967 FILE NO. M-2-23908

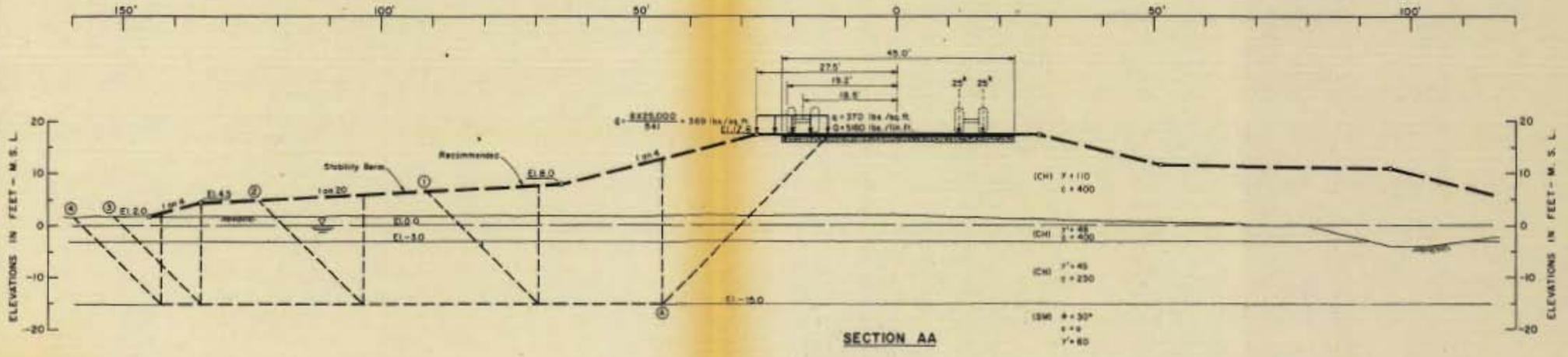
PLATE 52





ROAD RAMP		SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY
SECTION	EL.	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma\bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R / \Sigma\bar{D}$
AA	17.6	A	1	-15.0	51,492	19,904	31,588	22,480	8,000	13,760	42,240	1.34
			2			15,686	35,826		14,500	12,400	49,380	1.38
			3			10,079	41,413		22,375	10,000	54,855	1.32
			4			8,792	42,700		24,250	10,000	56,730	1.33
BB	12.0	B	1	-15.0	35,763	11,014	24,749	18,000	4,750	10,640	33,390	1.35
			2			9,584	26,179		7,750	10,000	35,750	1.37
			3			8,759	27,004		10,250	10,000	38,250	1.42
CC	5.0	C	1	-18.0	19,329	1,519	17,810	12,400	8,625	4,400	25,025	1.40

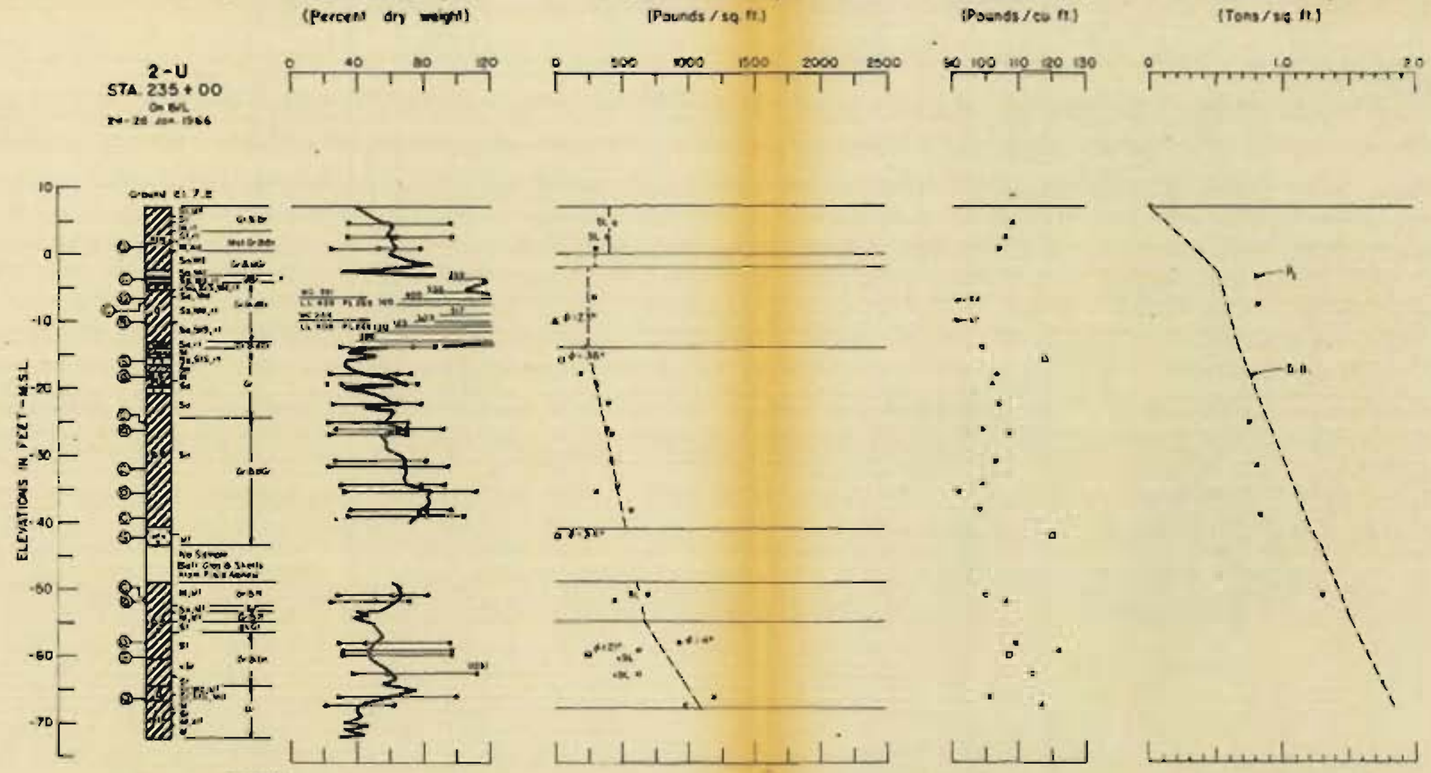


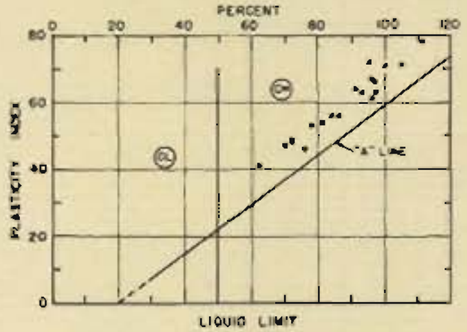


NOTE:
For general notes see plate 37

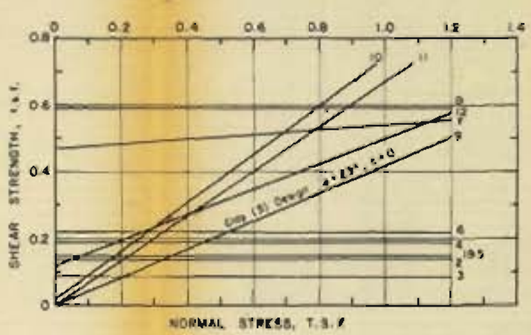
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
ROAD RAMP AT MICHOUD DOCK
(Q) STABILITY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

PLATE 53



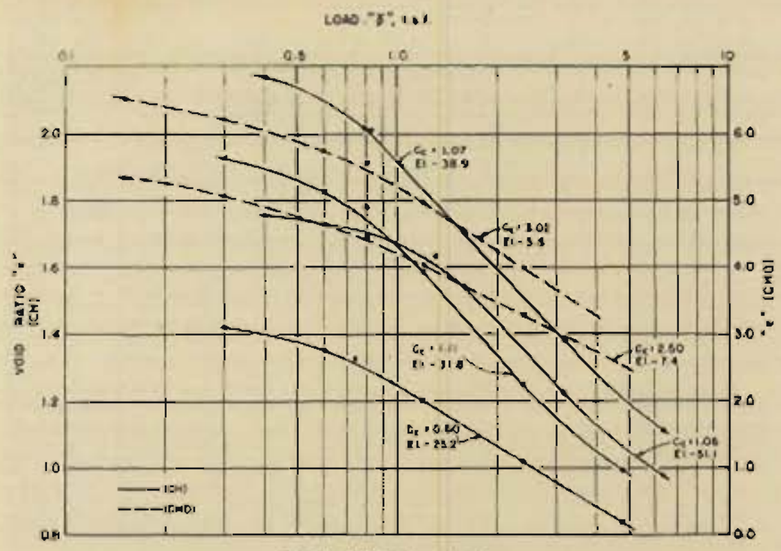


PLASTICITY CHART



ENVELOPE No.	EL.	TYPE	STRENGTH φ°	STRENGTH c (T.S.F.)	CLASS
1		Q	0	0.15	CH
2	-66			0.14	PT
3	-178			0.09	CH
4	-260			0.15	CH
5	-352			0.15	CH
6	-518		0	0.22	CH
7	-580		8	0.47	CH
8	-660		0	0.59	CH
9	-97	R	23	0	PT
10	-152	S	36	0.02	ML
11	-420		34	0	SM
12	-536		21	0.12	CH

SHEAR STRENGTH DATA



CONSOLIDATION DATA

GENERAL NOTES

- UC - Unconfined compression shear
- Ⓤ - Unconsolidated undrained triaxial shear
- Ⓒ - Consolidated undrained triaxial shear
- Ⓓ - Consolidated drained direct shear
- Ⓒ - Consolidation test
- w - Natural water content
- LL - Liquid limit
- PL - Plastic limit
- c - Unit cohesion
- φ - Angle of friction
- γ - Unit weight of soil - water system
- p - Normal stress
- OB - Overburden
- p_c - Preconsolidation pressure
- e - Void ratio
- C_c - Compression index

See Plate A for soil boring legend
See Plate 5B for detail shear test data
See Plate 2 for location of boring

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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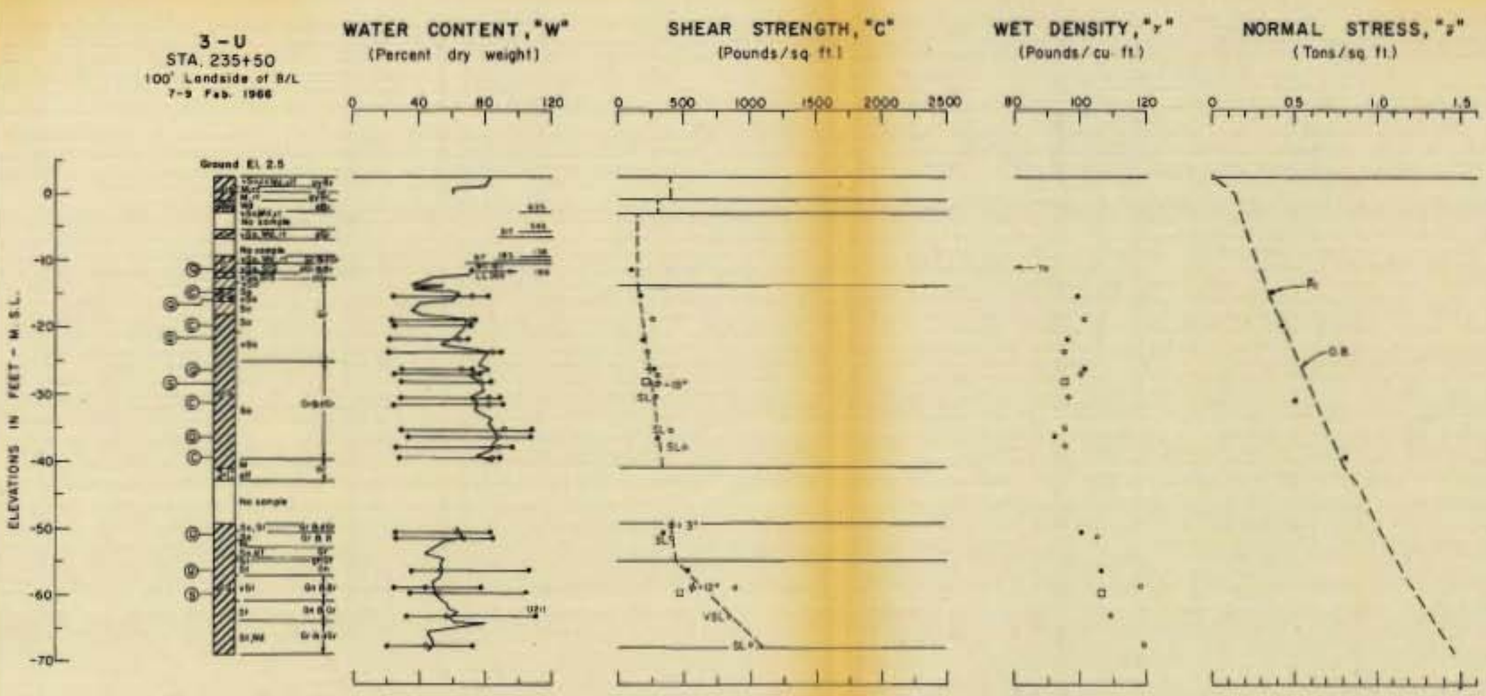
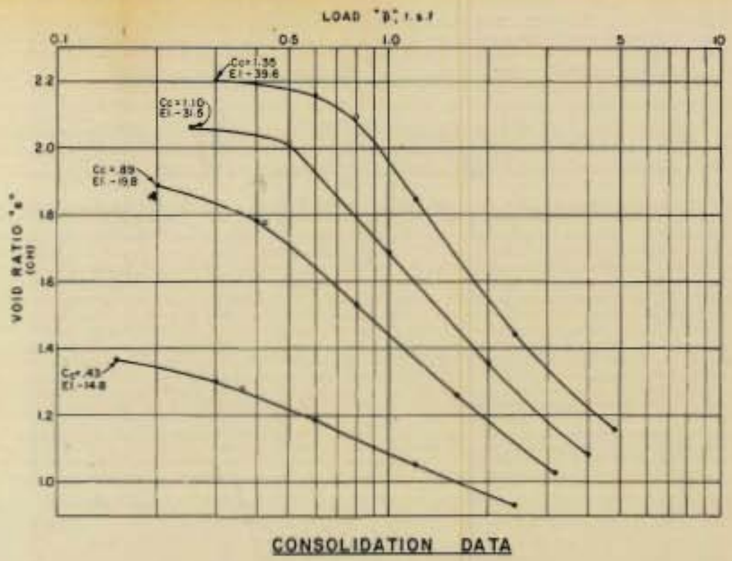
IHNC THRU NASA
UNDISTURBED BORING
2-U DATA
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. M-2-23908

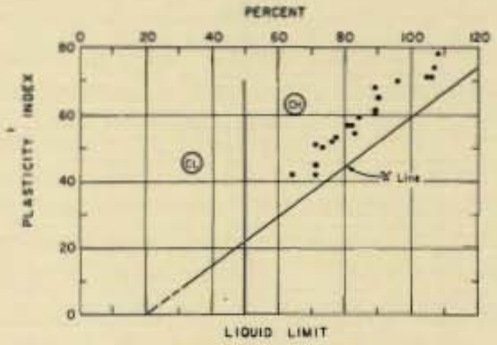
PLATE 54

3 - U
STA. 235+50
100' Landside of B/L
7-9 Feb. 1966

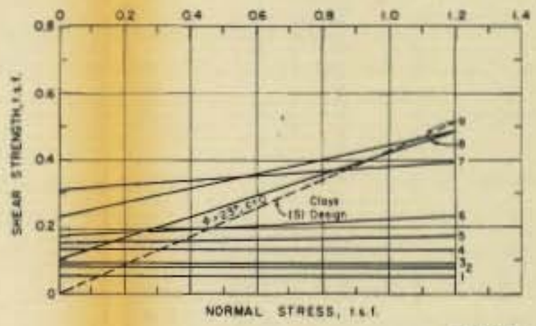




CONSOLIDATION DATA



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE No.	ENVELOPE El.	TYPE	STRENGTH φ°	STRENGTH C (t.s.f.)	CLASS
1	-11.5	Q	0	0.08	PI
2	-15.5	Q	0	0.08	CH
3	-21.5	Q	0	0.09	CH
4	-26.5	Q	0	0.13	CH
5	-36.5	Q	1	0.15	CH
6	-50.7	Q	3	0.17	CH
7	-56.5	Q	4	0.31	CH
8	-28.3	S	18	0.10	CH
9	-59.9	S	12	0.25	CH

See Plate A for soil boring legend
See Plate 54 for general notes
See Plate 59 for detail shear test data
See Plate 2 for location of boring

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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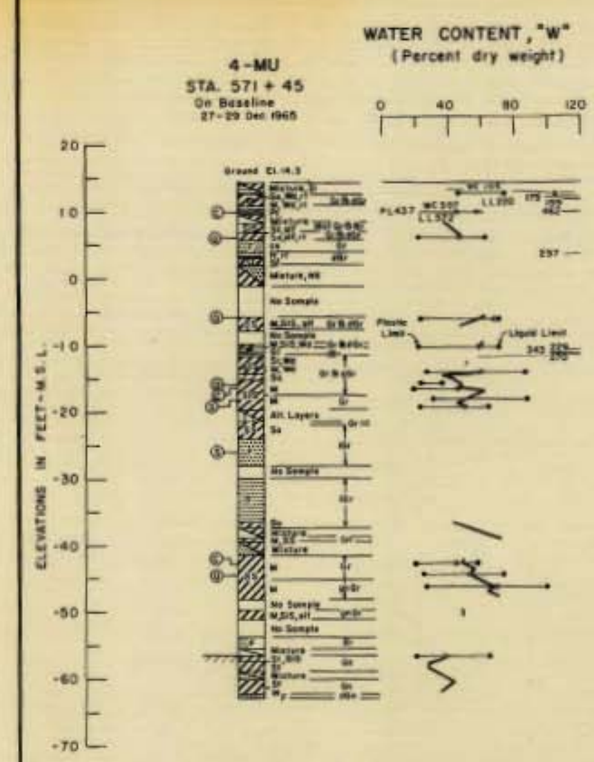
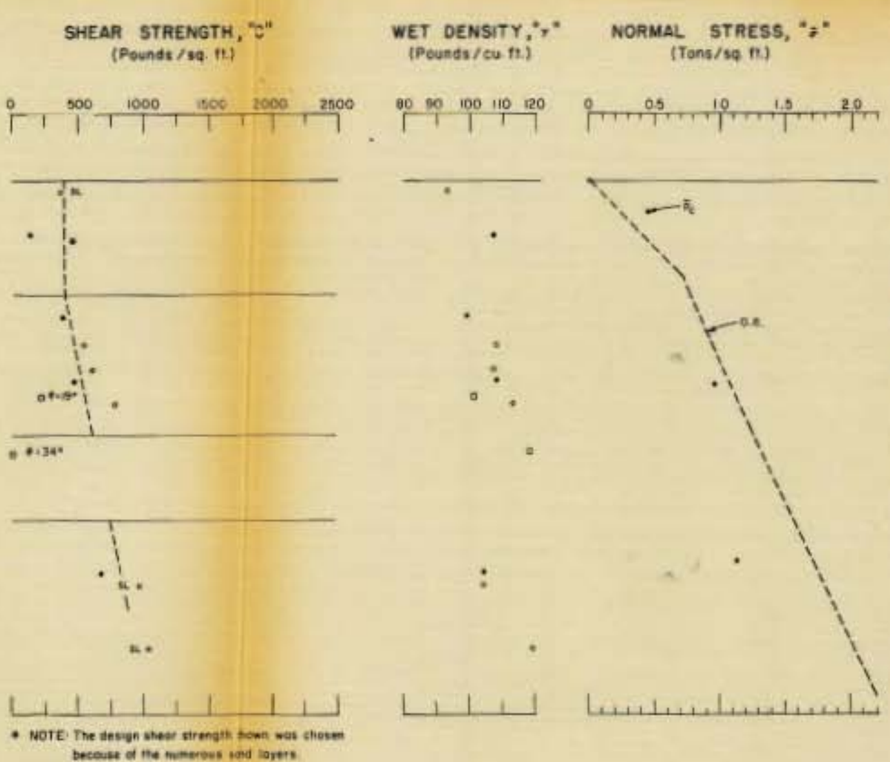
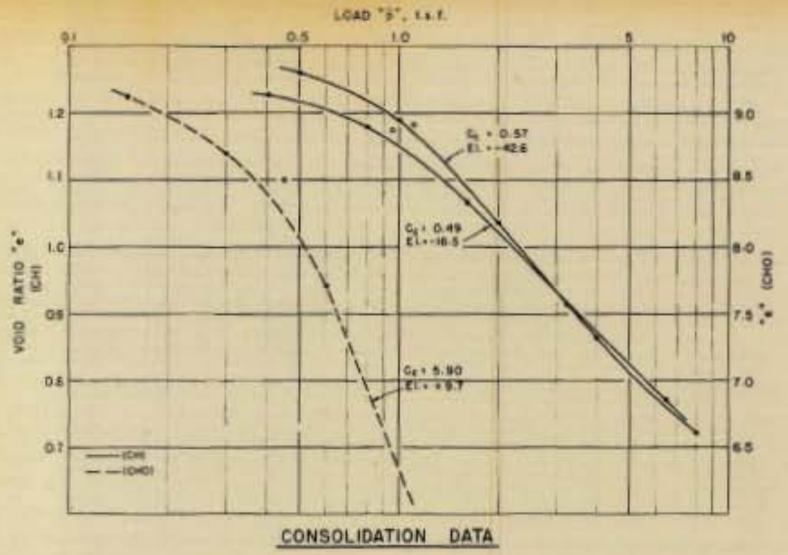
IHNC THRU NASA
UNDISTURBED BORING 3-U DATA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23908

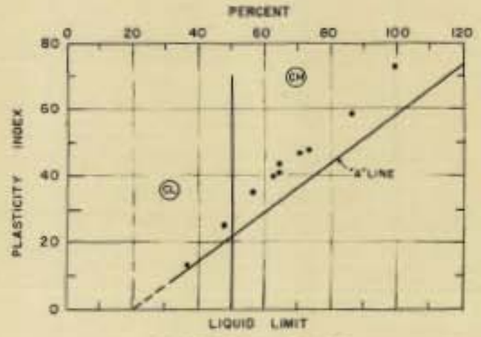
PLATE 55

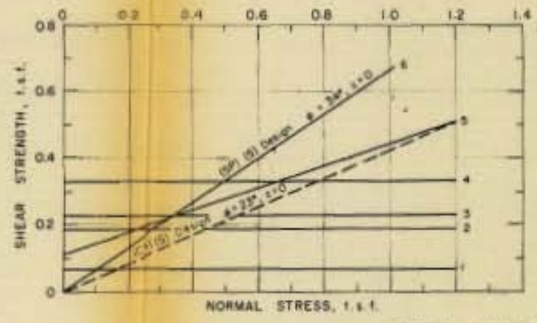




* NOTE: The design shear strength shown was chosen because of the numerous sand layers.







ENVELOPE No.	El.	TYPE	STRENGTH φ	STRENGTH c (t.s.f.)	CLASS.
1	-5.0	Q_c	0	0.07	CH
2	-8.0	Q_c	0	0.19	CH
3	-15.8	Q_c	0	0.23	CL
4	-44.5	Q_c	0	0.33	CH
5	-18.1	S	19	0.11	CH
6	-26.3	S	34	0.00	SP

See Plate A for soil boring legend
See Plate 54 for general notes
See Plate 59 for detail shear test data
See Plate 5 for location of boring

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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CITRUS BACK LEVEE
IHNC THRU NASA

UNDISTURBED BORING 4-MU DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1967
FILE NO. H-2-23909

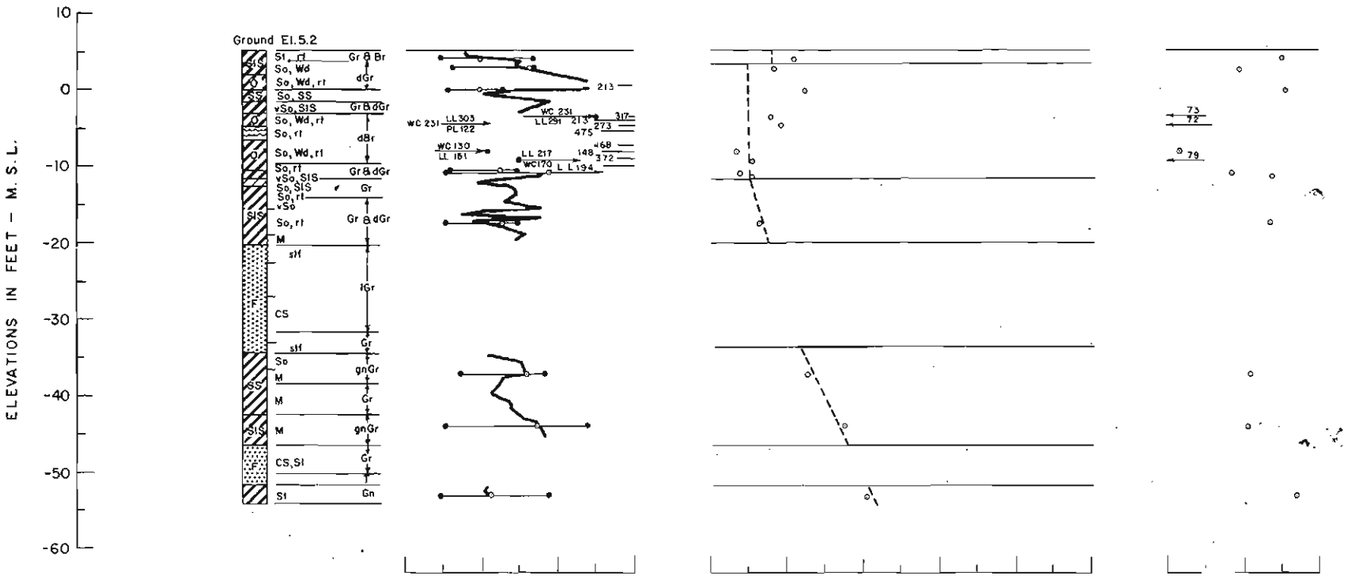
PLATE 56

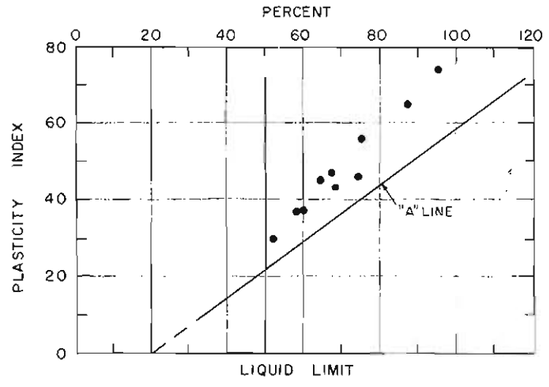
4-MUT
STA. 575+15
60' Right B/L
6-9 May 1966

WATER CONTENT, "W"
(Percent dry weight)

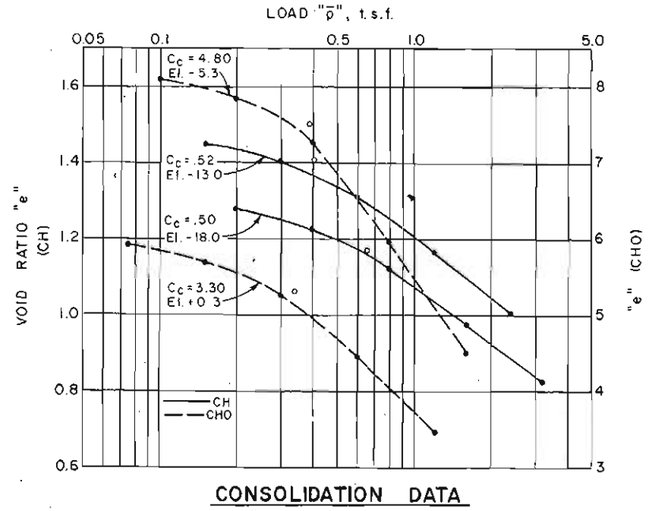
SHEAR STRENGTH, "C"
(Pounds/sq. ft.)

WET DENSITY, "γ"
(Pounds/cu. ft.)





PLASTICITY CHART



CONSOLIDATION DATA

See Plate A for soil boring legend
See Plate 54 for general notes
See Plate 5 for location of boring.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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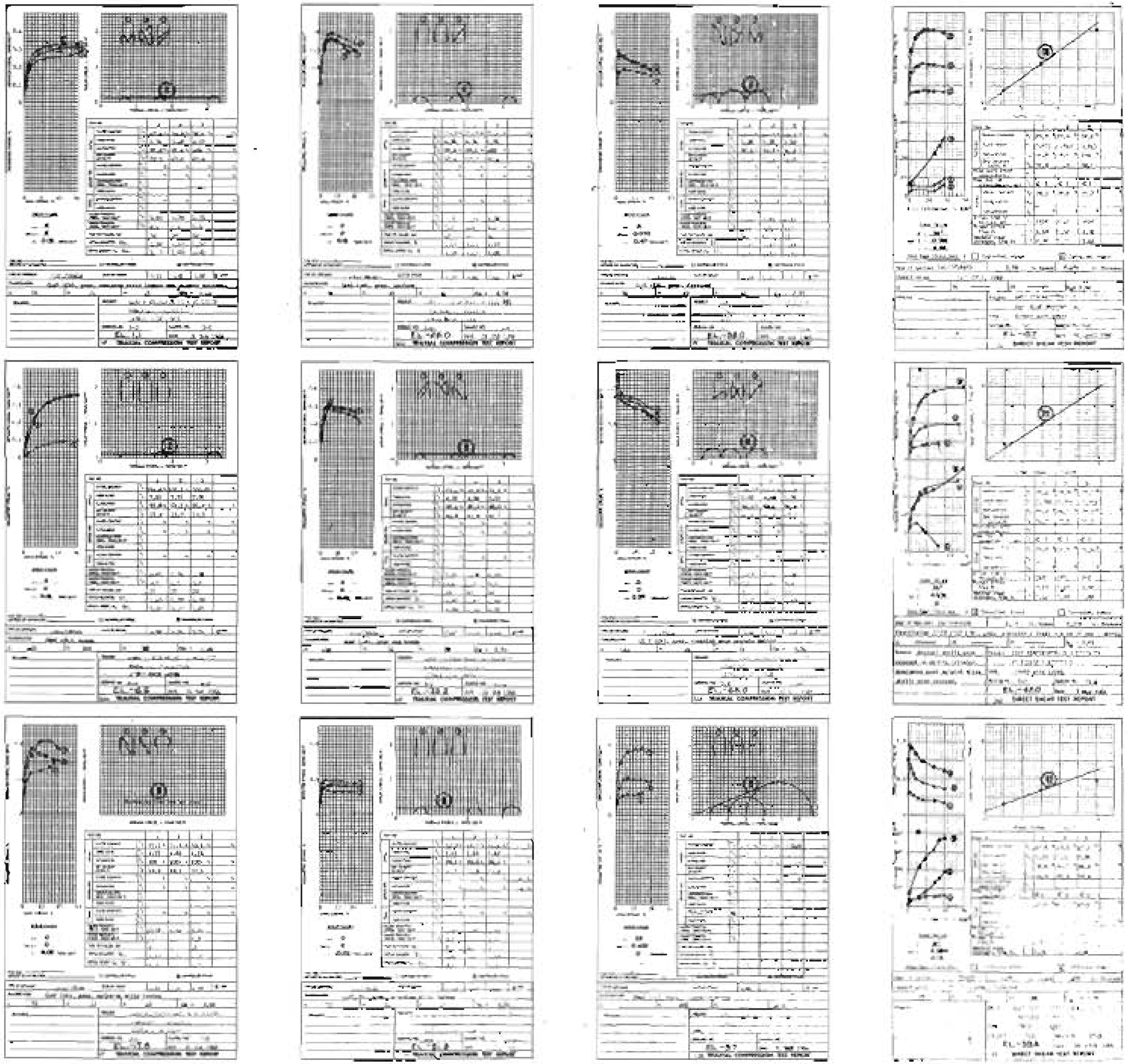
IHNC THRU NASA

UNDISTURBED BORING 4-MUT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-23908

PLATE 57



NOTE:

(1) Indicates reference number shown under shear data on Plate 54

(Q) = Unconsolidated - undrained triaxial compression test

(R) = Consolidated - undrained triaxial compression test

(S) = Consolidated - drained direct shear test

LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN

CITRUS BACK LEVEE

IHNC THRU NASA

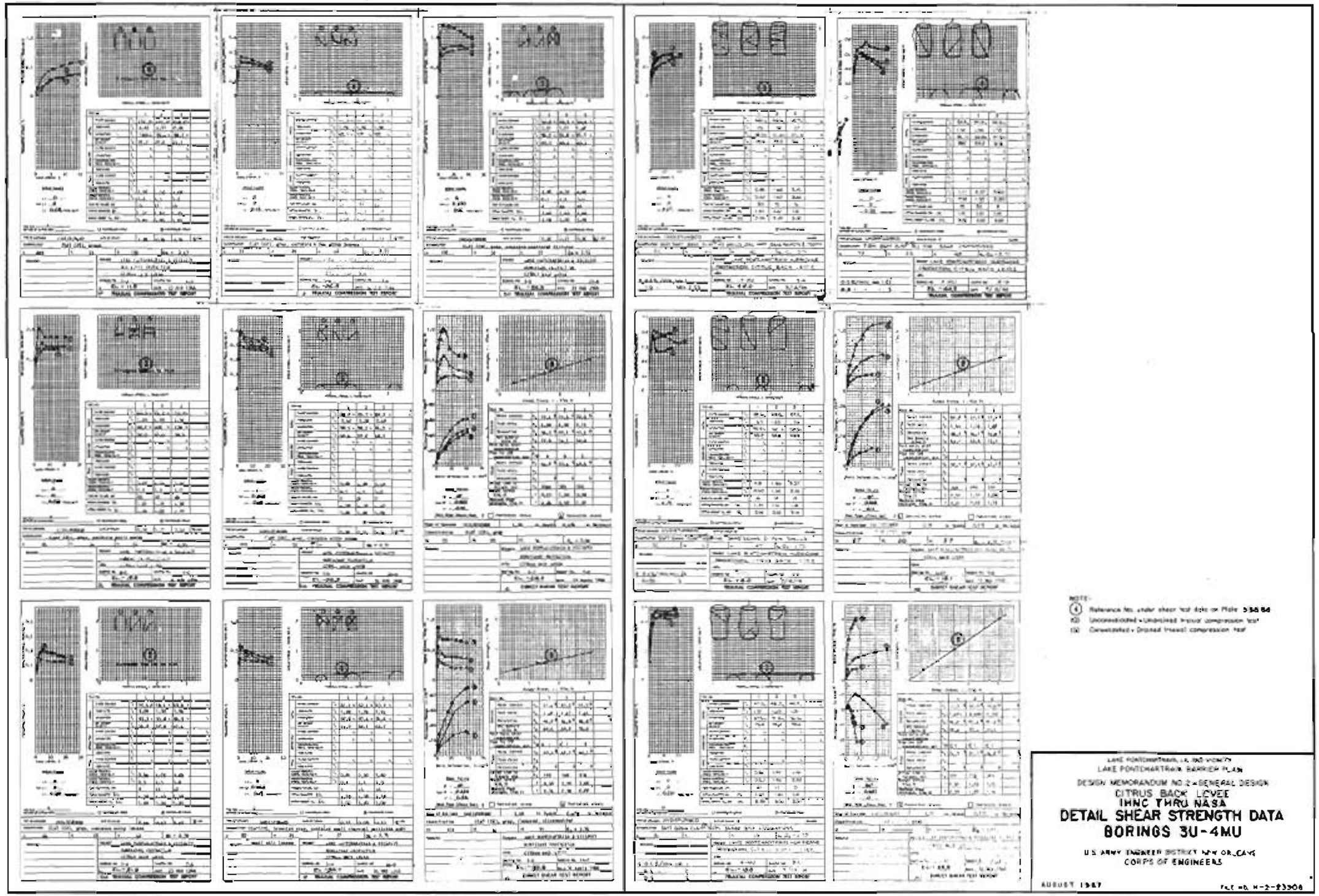
DETAIL SHEAR STRENGTH DATA

BORING 2-U

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

AUGUST 1967 | FILE NO. H-2-23908



NOTE:
(4) Reference No. under shear test data on Plate 59B 84
(U) Unconsolidated-Undrained triaxial compression test
(C) Consolidated-Drained triaxial compression test

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2-GENERAL DESIGN
CITRUS BACK LEVEE
IHNC THRU NASA
DETAIL SHEAR STRENGTH DATA
BORINGS 3U-4MU
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987
FILE NO. N-2-93308

PLATE 59